An Introduction to Research Methods for Undergraduate Health Profession Students

ACKNOWLEDGEMENT OF COUNTRY

James Cook University is committed to building strong and mutually beneficial partnerships that work towards closing the employment, health and education gap for Australian Aboriginal and Torres Strait Islander peoples. Our students come from many backgrounds, promoting a rich cultural and experiential diversity on campus. We acknowledge the Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the Australian lands and waters where our staff and students live, learn and work. We honour the unique cultural and spiritual relationship to the land, waters and seas of First Australian peoples and their continuing and rich contribution to James Cook University and Australian society. We also pay respect to ancestors and Elders past and present.

Kassandra Savage (JCU Alumni), 'Coming Together and Respecting Difference', acrylic on canvas, 2014, 90cm x 90cm. © Kassandra Savage, reproduced with permission of the artist

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INTRODUCTION

This introduction to research methods eBook aims to provide undergraduate health professions students with appropriate guidance, knowledge and skills that are essential for research. Research is a process that produces new knowledge through scientific inquiry-based methods. Consequently, embarking on a successful research project requires critical planning and a good understanding of research methodologies. This eBook is packed full of practical tips and examples to equip students with the knowledge to conduct research, making it invaluable for students embarking on health research for the first time. The book covers the entire research process, starting with developing a research question, qualitative and quantitative research approaches, ethical considerations, data collection and analysis and the dissemination of the results of the study. Other contents covered in this book include conducting a literature review, designing a questionnaire, designing an interview guide and writing a research proposal. The engaging and insightful content in this book is focused on the needs and interests of undergraduate health professions students who are considering whether to undertake research but do not know where and how to begin and wish to understand the research evidence base for their profession. The eBook also has H5P activities such as interactive videos, presentations and quizzes that will enable students to connect theory with practice. Given its unrivalled and rich content, this e-book will be an essential partner for undergraduate health professions students who have little or no background in engaging with research. It will support the students in pursuing interests in research and making contributions to the existing body of evidence-based research. Ultimately, this eBook will contribute to the development of tomorrow's clinical researchers and future leaders in the advancement of health professions research.

There has been an ongoing global concern that the number of health professionals undertaking research is declining, with reference to the clinical researcher as an 'endangered species'. Research training and experience in undergraduate education is therefore essential to foster motivation and engagement. It is important to make research understandable, especially to undergraduate health professions students who will eventually proceed into clinical practice. Understandably, research can be seen or viewed as a daunting task by students given the broad and sometimes complex concepts that they are required to understand before they can embark on research. This eBook will simplify and break down these concepts for the students. The free availability of this eBook will make it a lifelong companion for the students that can be referred to even after completing their degree. Currently, textbooks on research in health professions are either expensive or too complex for undergraduate students to understand. This eBook will bring research to life and address all these gaps.

1. INTRODUCTION TO RESEARCH

"Research is creating new knowledge"– Neil Armstrong

In this chapter you will learn about:

- what it means to do research
- ways of knowing and world views
- the scientific method and how it contributes to evidence
- where research questions come from and how do they evolve
- reasons for doing research in healthcare settings.

Opening Scenario

Imagine that you are a third-year medical student living on campus and relying solely on the cafeteria for your meals as you do not know how to cook. An excellent opportunity to develop basic culinary skills presents itself; you enrolled in the 'cooking basics for dummies' class for your third-year elective subject. For your final assessment, you are required to put on your creative thinking cap, research how to make sushi on the internet and, within an allocated time of one hour, make a special type of sushi. You decide to take on the challenge by changing the filling you used in your sushi from popular choices such as salmon or chicken to kangaroo meat to give the meal an 'Australian touch'. You did such a good job of it that you got the highest grade (high distinction) in the class. While sushi is a known and existing meal, you have added more to the knowledge base by creating a new sushi recipe. Similarly, research involves creating new ideas and knowledge. No wonder Neil Armstrong stated that "*Research is creating new knowledge"*.

Let's now take you into the world of research where you need to creatively develop and apply processes (recipes) that produce new knowledge about phenomena under investigation.

Sushi is a Japanese dish made out of vinegared rice and a variety of other ingredients.

1.1 PURPOSE OF RESEARCH

What do you think of when you hear the word "*Research*"? Trying to seek answers to a question is research. Interestingly, we apply research in our daily lives without realizing it. For example, developing a creative sushi recipe or deciding on buying a house requires research. If everyday activities require research, then what is research? The Cambridge dictionary defines research as a thorough investigation of a topic or subject to learn new information or develop knowledge of it.[1] According to Francis Dane (1990), research is a critical process that involves asking and attempting to answer questions about the world.[2] Sometimes, asking and trying to answer questions could include using a questionnaire, an interview, an experiment, and sometimes an entirely new method. Research as a process is a valuable tool that allows us to examine all the qualities of something or a topic – good, bad, or indifferent.[2] Therefore, it is important to critically evaluate the answers we receive because not every answer we obtain is correct or applicable to certain situations, even when it is a popular opinion.[2] Thus, research helps us to demystify myths.

To explain this further, consider and respond to the case below:

You are a second-year pharmacy student on placement at the local pharmacy. Mrs C, a 70-year-old resident of the town, is your first client for the day, and she is a type 2 diabetic patient who has come to buy medications. She tells you that she heard about a new drug that helps to balance blood sugar levels for people with diabetes, and she was wondering if your pharmacy had supplies of this medication. When she shared the name of the drug with you, you were not sure if it was approved for the treatment of diabetes as it was not a familiar name, and your pharmacy does not stock the medication. Nonetheless, you decided to look up research done to confirm its authenticity. Your search showed that the drug was a supplement advertised as a treatment for diabetes but had been recently flagged by the Australian Therapeutic Goods Agency (TGA) as an unapproved treatment for diabetes. This scenario portrays that not every advertised drug is safe for use, and it emphasises the importance of research to create new knowledge. How would you communicate this to Mrs C?

Use the Padlet below to articulate your viewpoint.

1.2 WAYS OF CREATING KNOWLEDGE

What constitutes knowledge?

To have a deep understanding of what research entails, we need to first consider the historical context of ways of creating knowledge and what constitutes knowledge. Remember that "Research is creating new knowledge". Our knowledge, thoughts, perceptions and actions are influenced by our worldview, which is a collection of attitudes, values, tales, and expectations about the world.[3] One's view of the world is at the heart of one's knowledge. There are different methods of acquiring knowledge, including intuition, authority, logical reasoning and the scientific method.[4]

Intuition

Cambridge dictionary defines intuition as the knowledge from an ability to understand or know something immediately based on feelings rather than facts.[1] It is also described as instinctive knowing without the use of cognitive processes or emotionally charged judgments that result from quick, unconscious, and holistic associations.[5] The impression that something is right comes from intuition. Instincts and intuition are sometimes used interchangeably.[4] Justifications like "that feels right to me" are often used to support intuition. However, as there is no means to evaluate the accuracy of the knowledge based on intuition, there is no way to distinguish between accurate and inaccurate knowledge using such an approach. As a result, it is challenging to assess the correctness of intuition in the absence of action.[4] In research, intuition may lead to generating hypotheses, especially in areas with limited or no prior information. Nonetheless, the hypothesis has to be tested before the knowledge is accepted in modern healthcare settings.

Authority

Getting knowledge from an authority figure is another common way of acquiring knowledge.[6] Authority refers to a person or organization having political or administrative power, influence and control. The information generated from such authority is regarded to be true since it was expressed by a social media influencer or an expert in a certain field.[4] This approach entails embracing novel concepts because an authority figure declares them true.[4] It is one of the quickest and simplest ways to learn; therefore, it can often be a good place to start.[6] Some of these authorities are parents, the media, physicians, priests and other religious leaders, the government, and professors.[4] Although we should be able to trust authority figures in an ideal world, there is always a

chance that the information they provide may be incorrect or out of context.[4] War crimes such as the Holocaust and the Guatemala Syphilis research, where atrocities against humanity were committed, are only a few instances when people blindly listened to authoritative leaders without scrutinising the information they were given.[4] Information on research topics obtained from authorities could generate new ideas about the concept being investigated. However, these ideas must be subjected to rigorous scientific scrutiny rather than accepted at face value.

Logical reasoning

Logic reasoning or rationalism is any process of knowledge generation that requires the application of reasoning or logic.[4] This approach is predicated on the idea that reason is the primary source of knowledge.[6] It is based on the premise that people can discover the laws that govern the behaviour of natural objects through their efforts.[6] Human behaviour is frequently explained using rationalism. In order to reach sound conclusions utilising this method, premises are provided, and logical principles are followed. However, if any assumptions are wrong, then the conclusion will be invalid.[4] For example, if a student fails to attend a series of compulsory lectures or tutorials, the professor may reason that the student is taking a lackadaisical approach to the subject. However, the assumption that attendance is an indicator of engagement may be untrue and lead to an erroneous conclusion. Perhaps, the student may have been ill or genuinely absent for some other unavoidable reason. This highlights the disadvantage of rationalism, as relying solely on this approach could be misleading, leading to inaccurate conclusions.[4] Thus, while rationalism may be helpful when developing or thinking of a research hypothesis, all research hypotheses need to be tested using the scientific method.

Scientific method

The scientific method is an empirical method for systematically gathering and analysing data to test hypotheses and answer questions.[4] Let's go back to our example of the professor who concluded that the student who skipped the required classes had a lax attitude. This could possibly be due to some prior interactions with students who had demonstrated a lack of interest in studying the subject. This illustration shows the fallacy of drawing conclusions solely from experience and observation. The amount of experience we have could be constraining, and our sensory perceptions may be misleading.[4] Therefore, it is important to use the scientific method, which allows the researcher to observe, ask questions, test hypotheses, collect data, examine the results and draw conclusions. While researchers often draw on intuition, authority, and logical reason to come up with new questions and ideas, they don't stop there.[4] In order to test their theories, researchers utilise systematic approaches by making thorough observations under a variety of controlled situations to draw reliable conclusions.[6] Systematic techniques are used in scientific methods, and every technique or design has a set of guidelines or presumptions that make it scientific.[4] Thus, empirical evidence based on

observations becomes an item of knowledge. In the following chapters, we will go into greater detail about what the scientific method comprises.

How does scientific method contribute to evidence?

While everyday activities such as cooking, as seen in the opening scenario, may involve research, this type of research may not involve a systematic or controlled approach. Scientific research requires a systematic approach, and it is defined as a systematic inquiry/data-gathering process used to investigate a phenomenon or answer a question.[4] Research is also a way of knowing that involves critical examination of various aspects of a given phenomenon that is under investigation. It requires formulation and understanding of principles that guide practice and the development and testing of new ideas/theories.[7] Research aims to be objective and unbiased and contributes to the advancement of knowledge. Research adds to existing knowledge by offering an understanding or new perspective on a topic, describing the characteristics of individuals or things, or establishing causal links between factors.[8]

1.3 RESEARCH PARADIGMS AND PHILOSOPHICAL ASSUMPTIONS

Research involves answering questions, and the approach utilised is based on paradigms, philosophical assumptions, and distinct methods or procedures. Researchers' approaches are influenced by their worldviews which comprise their beliefs and philosophical assumptions about the nature of the world and how it can be understood.[9] These ways of thinking about the world are known as research paradigms, and they inform the design and conduct of research projects.[10,11] A paradigm constitutes a set of theories, assumptions, and ideas that contribute to one's worldview and approach to engaging with other people or things. It is the lens through which a researcher views the world and examines the methodological components of their research to make a decision on the methods to use for data collection and analysis.[12] Research paradigms consist of four philosophical elements: axiology, ontology, epistemology, and methodology.[10] These four elements inform the design and conduct of research projects (Figure 1.1), and a researcher would have to consider the paradigms within which they would situate their work before designing the research.

Ontology

Ontology is defined as how reality is viewed (nature of reality) – accurately captured as an entity or entities. It is the study of being and describes how the researcher perceives reality and the nature of human engagement in the world.[13,14] It is focused on the assumptions researchers make to accept something as true. These assumptions aid in orientating a researcher's thinking about the research topic, its importance and the possible approach to answering the question.[12] It makes the researcher ask questions such as:

- What is real in the natural or social world?
- How do I know what I know?
- How do I understand or conceptualise things?

In healthcare, researchers' ontological stance shapes their beliefs about the nature of health, illness, and healthcare practices. Here are a few examples of ontological stances that are commonly adopted by researchers in healthcare:

- Biomedical ontological stance: This ontological stance assumes that biological mechanisms can explain health and illness and that the body is a machine that can be studied and fixed when it malfunctions.[11] Researchers who take a biomedical ontological stance tend to focus on medical interventions such as drugs, surgeries, and medical devices.
- Social constructivist ontological stance: This ontological stance assumes that health and illness are social constructs that are shaped by cultural and social factors.[13] Researchers who take a social constructivist ontological stance tend to focus on understanding the social and cultural context of health and illness, including issues such as health disparities, patient-provider communication, and the role of social determinants of health.
- Critical realist ontological stance: This ontological stance assumes that there is a reality that exists independently of our perceptions but that our understanding of that reality is always partial and mediated by our social context.[11,14] Researchers who take a critical realist ontological stance tend to focus on understanding the complex interactions between social and biological factors in health and illness.

Epistemology

Epistemology is the branch of philosophy that deals with the study of knowledge and belief. It describes the ways knowledge about reality is acquired, understood, and utilised.[15] This paradigm highlights the relationship between the inquirer and the known –what is recognised as knowledge. Epistemology is important because it helps to increase the researcher's level of confidence in their data. It influences how researchers approach identifying and finding answers while conducting research.[12] In considering the epistemology of research, the researcher may ask any of the following questions:

- What is Knowledge?
- How do we acquire knowledge and what are its limits?
- Is it trustworthy? Do we need to investigate it further?
- What is acceptable knowledge in our discipline?

The epistemological stance of healthcare researchers refers to their fundamental beliefs about knowledge and how it can be acquired. There are several epistemological stances that researchers may take, including positivism, interpretivism, critical theory, and pragmatism.

- Positivism: This epistemological stance is grounded in the idea that knowledge can be gained through objective observation and measurement.[11] Researchers who adopt a positivist stance aim to create objective, measurable, and replicable research that can be used to predict and control phenomena. For example, a researcher studying the effectiveness of a medication might conduct a randomized controlled trial to measure its impact on patient outcomes.
- Interpretivism: This epistemological stance is based on the belief that knowledge is constructed through human interpretation and social interactions. It emphasizes the subjective and interpretive nature of human experience.[13, 14] Researchers who adopt an interpretivist stance seek to understand the subjective experiences of individuals and the meanings they attach to their experiences. For example, a researcher studying the experience of chronic pain might use qualitative methods to explore patients' narratives and perspectives on living with pain.
- Critical theory: This epistemological stance is grounded in the belief that knowledge is shaped by power dynamics and social structures.[14] Researchers who adopt a critical theory stance seek to uncover and challenge power imbalances and injustices in society. For example, a researcher studying

healthcare disparities might use critical theory to explore the ways in which social and economic factors contribute to inequities in access to healthcare.

- Pragmatism: This epistemological stance is focused on the practical application of knowledge. Researchers who adopt a pragmatic stance aim to create research that is both theoretically sound and applicable to real-world settings.[13] For example, a researcher studying the implementation of a new healthcare intervention might use mixed methods to gather both qualitative and quantitative data to understand how the intervention is working in practice.

Overall, researchers' epistemological stances have important implications for the questions they ask, the methods they use, and the interpretations they make. Understanding researchers' epistemological stances can help healthcare professionals and policymakers to critically evaluate research findings and to consider the broader social, cultural, and political contexts that shape health and healthcare.

Axiology

Axiology refers to the researcher's understanding of values and their role in research. It examines values, deals with issues of right and wrong and measures the level of development and types of perceptual biases.[9] Axiology explains the role and importance of the research process, considers the values researchers assign to their research, and guides their pursuit of knowledge.[10] It makes the researcher consider the following questions:

- What should be done to uphold and respect the rights of each participant?
- What ethical principles will you follow during your research?
- What are the cultural and intercultural issues to be considered in the research?
- How can I conduct the research ins a respectful manner?
- How can we minimise or reduce risk during the research?

Researchers' axiological stance in healthcare refers to their values, beliefs, and ethical positions that guide their research practices and interpretations of findings. Here are some examples of axiological stances that researchers may take in healthcare:

- Patient-centeredness: This value emphasizes the importance of incorporating patients' perspectives, values, and preferences in healthcare decision-making.[9] For example, a researcher may prioritize qualitative research methods to explore patients' experiences and needs in a specific healthcare setting.

- Evidence-based practice: This value emphasizes the use of the best available evidence to guide clinical decision-making.[14] For example, a researcher may conduct a randomized controlled trial to evaluate the effectiveness of a new medication or intervention.
- Health equity: This value emphasizes the importance of addressing health disparities and promoting fairness and justice in healthcare.[9] For example, a researcher may use a community-based participatory research approach to engage with marginalized or underrepresented populations and identify solutions to health inequities.
- Cultural humility: This value emphasizes the importance of acknowledging and respecting cultural differences and avoiding assumptions and stereotypes in healthcare interactions.[10] For example, a researcher may use qualitative research methods to explore the perspectives and experiences of patients from diverse cultural backgrounds.

These axiological stances are not mutually exclusive and can be combined in various ways depending on the research question and context.

Methodology

Methodology is the strategy or action plan that informs the choice and use of particular methods within the context of a particular research paradigm.[11,16] The term methodology refers to the study design, methods, and procedures employed in a well-planned investigation to find answers. Examples include data collection, survey instruments, participants, and data analysis. In considering the methodology, researchers would ask the questions:

- How do I find out more about this reality?[17]
- What approaches or methodology shall I use to obtain the data that will enable me to answer my research question?[12]

The main types of methodology include quantitative and qualitative research. In some cases, mixed methods research, i.e., a combination of quantitative and qualitative research, may also be used. Researchers' methodological stance in healthcare refers to their underlying beliefs and approach to conducting research in this field. Here are three examples of methodological approaches in healthcare research:

- Quantitative: This approach emphasizes objective and empirical measurement and relates to positivism. Quantitative researchers assume that there is a single objective reality and that the purpose of research is to discover the truth.[11] For example, a researcher using a quantitative, positivist

approach might conduct a randomized controlled trial to determine the efficacy of a new medication for treating a specific condition.

- Qualitative: This approach emphasizes the importance of understanding multiple perspectives and the subjective experiences of individuals.[14, 18] Qualitative researchers believe that reality is socially constructed and that the purpose of research is to generate new insights and understandings. For example, a researcher using a constructivist approach might conduct a qualitative study to explore how patients experience a particular health condition and how it affects their daily lives.
- Mixed methods: This approach emphasizes the use of multiple methods and the importance of adapting research to specific contexts and goals.[13, 19] Researchers who use this approach are pragmatists and they believe that research should be practical and useful for addressing real-world problems. For example, a researcher using a pragmatic approach might conduct a mixed-methods study to evaluate a new healthcare intervention, using both quantitative measures of effectiveness and qualitative data to understand patient experiences and preferences.

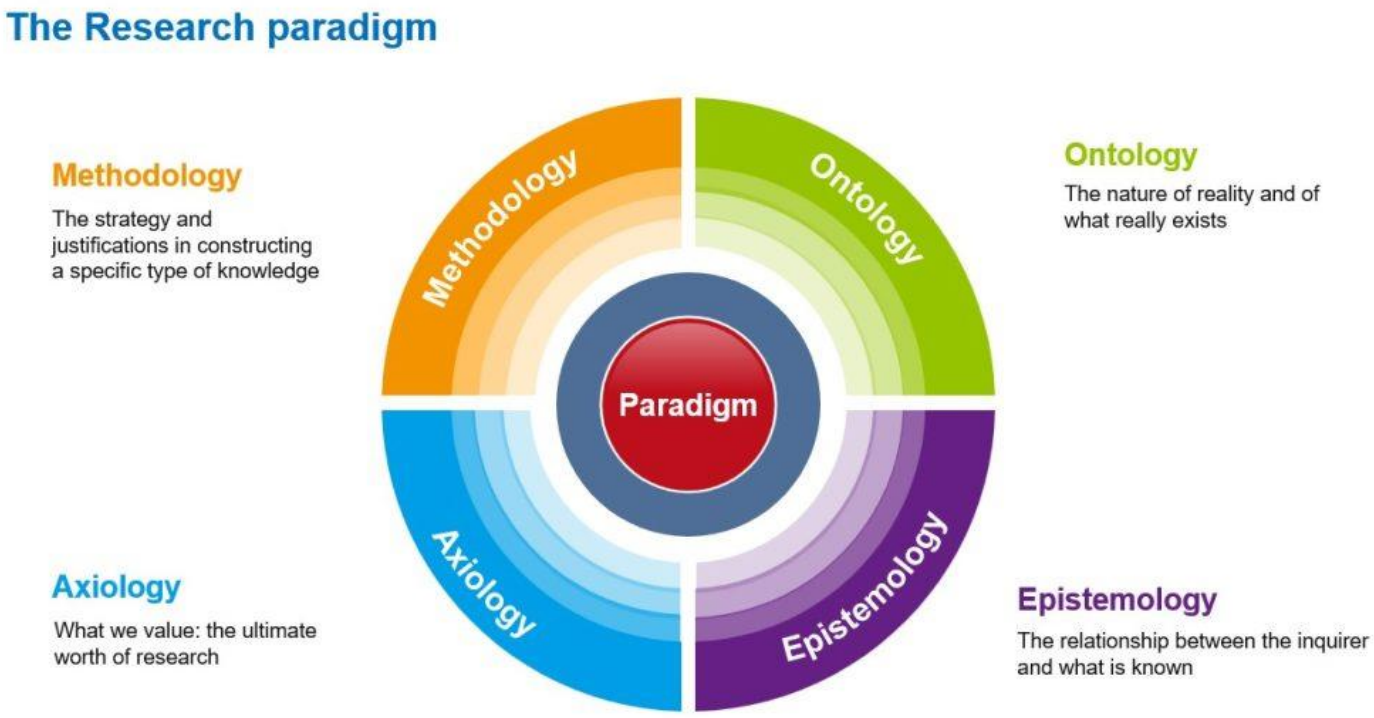

Figure 1.1 The Research Paradigm by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

1.4 TYPES OF RESEARCH

The choice of research philosophy determines the approach a researcher would use. The approaches in research are deductive and inductive reasoning. Deductive reasoning is derived from the word deduce, which means to conclude by thinking about known facts. Deductive reasoning is the approach used in quantitative research. Research using this approach.[20] Deductive reasoning is linked with the positivism paradigm. This approach involves systematically collecting, analysing, and interpreting data to draw inferences.[20] In simple terms, the deductive researcher uses the top-down approach that uses data to test a theory or hypothesis and gather knowledge (adding, qualifying, or contradicting the scientific meaning).[20]

In contrast, inductive reasoning moves from specific observations to broader theories and generalisations.[20] Inductive reasoning is commonly employed in qualitative research and focuses on specific observations, identifies patterns and uncovers conceptual relationships that could be explored to generate themes or a *theory* based on the data collected.[20] Inductive reasoning uses a bottom-up approach and it is linked with constructivism/interpretivism paradigm.

Distinguishing Features of Quantitative, Qualitative, and Mixed Methods Research

There are three main research methodologies – quantitative, qualitative and mixed methods. Quantitative research seeks to investigate and understand the relationship between different variables.[21] It is concerned with employing numerical data to systematically examine the phenomenon under investigation. As a result, quantitative research relies on measurement and makes the assumption that the phenomena being studied can be quantified. It aims to analyse data for patterns and validate the measurements by using statistical methods to draw conclusions about the likelihood of the numbers measured/sampled being widely representative. While it effectively measures quantifiable things like height and weight, measuring other things, like what people think or feel, is more challenging.[21] This is where qualitative research is required.

Qualitative research is a naturalistic type of inquiry that deals with non-numerical data. Instead of attempting to explain and manipulate factors, qualitative research aims to explore and comprehend the factors.[22] For example, it can be used to understand people's perceptions of a particular concept or phenomenon. It emphasises the process or patterns of development rather than the result or output of the research since it is contextualised and interpretive.[22] Data collection methods in qualitative

research include interviews, field notes, diaries, and observations. Data are gathered and qualitatively analysed in pure qualitative research.[22]

Mixed method research, on the other hand, involves a combination of both quantitative and/ or qualitative methods.[23] The methodology requires a purposeful mixing of the approaches required in the data collection, data analysis and interpretation of the research. The features of both qualitative and quantitative methods are integrated into this research methodology.[23]

Figure 1.2 presents the differences between quantitative and qualitative research. These methodologies will be explicitly discussed in subsequent chapters.

Figure 1.2 Differences between quantitative and qualitative research by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

1.5 CONCLUSION

In this chapter, you have learned *what* research means, the reasons for doing research in healthcare setting and how it contributes to evidence. Indeed, Neil Armstrong's statement that "Research is creating new knowledge" accurately captures the essence of the research process. The process of research involves identifying a research problem or question, conducting a literature review to understand what is already known about the topic, formulating a hypothesis or research question, designing a study to test the hypothesis or answer the research question, collecting and analysing data, and finally drawing conclusions and sharing the findings with the wider community.

The process of research entails the systematic investigation and exploration of a particular topic or subject with the aim of discovering new information, insights, and understanding of existing knowledge. Through research, we are able to develop new ideas, theories, and concepts and apply them to solve practical problems. Just like creating a new recipe, research involves creativity, critical thinking, and problem-solving skills. In the same manner that the medical student in the opening scenario used their creativity and research skills to create a new sushi recipe, researchers use their expertise and knowledge to generate new knowledge that contributes to the advancement of their respective fields. Research plays a critical role in advancing science, technology, medicine, and many other health professions fields, and has helped to shape the way we understand and interact with the world around us.

In conclusion, the video clip and the research onion diagram below summarise the different stages required to develop an effective research.

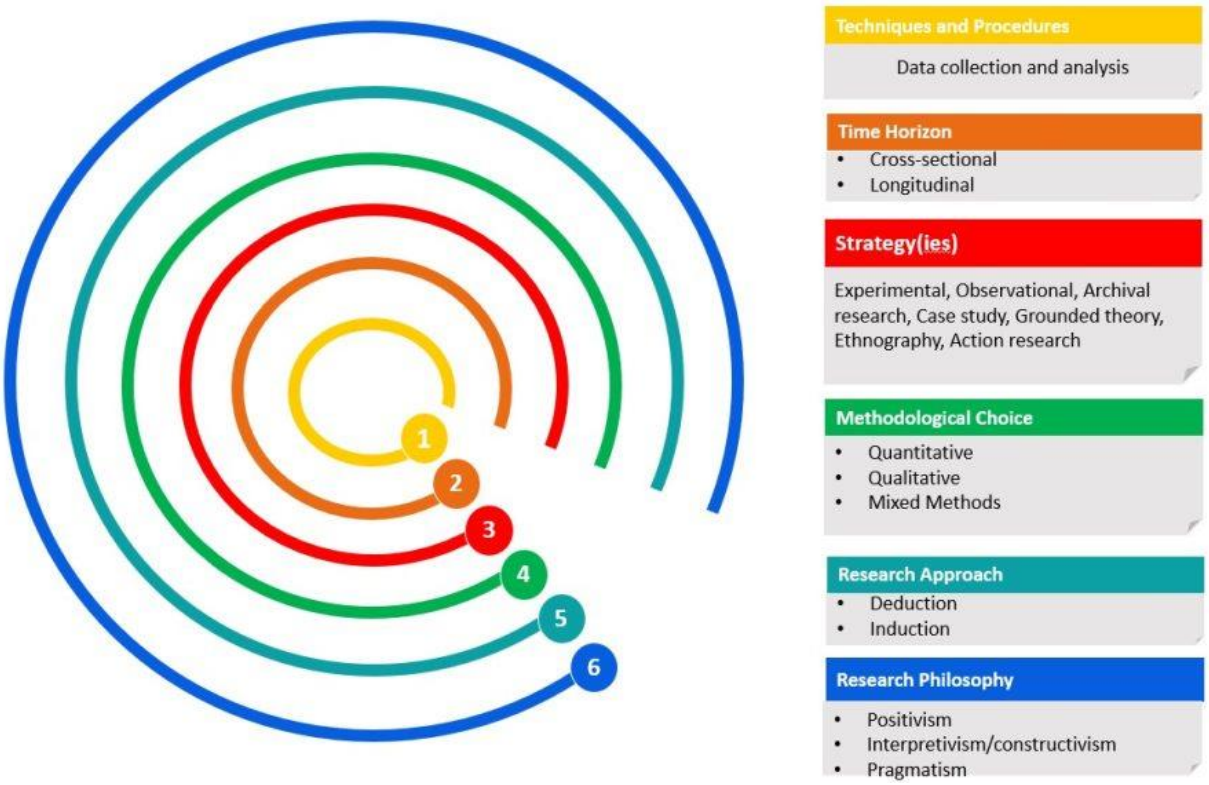

Figure 1.3 The research onion by Bunmi Malau-Aduli and Faith Alele, used under a

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2. PLANNING A RESEARCH PROJECT

"A goal without a plan is just a wish" – Antoine de Saint Exupery

In this chapter you will learn about:

- the research process
- identifying knowledge gaps
- choosing a research topic
- developing a research question
- types of Literature reviews.

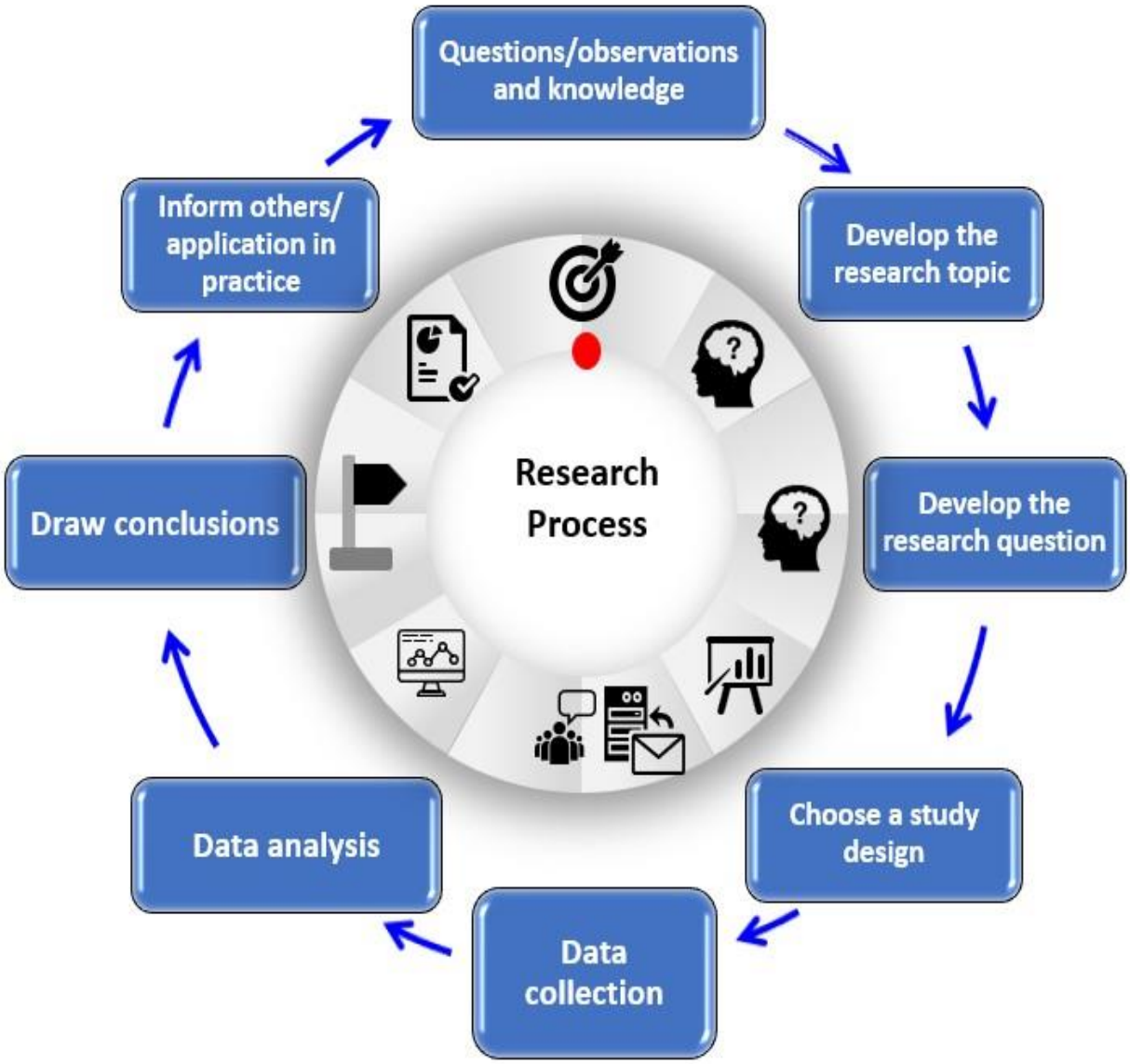
Opening Scenario

As *Antoine de Saint Exupery* has stated, "a goal without a plan is just a wish". Imagine that you are going on a road trip with your family, you've got all your things packed, and everyone in the family is so excited, but then after driving around in circles for 3 hours, you realise that you don't know how to get to your destination. You and your family feel frustrated and dissatisfied with the trip. You all acknowledge that you definitely won't be able to reach your destination without a detailed plan of how to get there. Thankfully, with the advancement of technology, you can use the GPS to navigate through and find your way. First, the GPS provides you with the best route, and it steers you away from traffic congestion. It lets you know when you have gone off course and gives you directions to get back on track. You are able to see your progress as you proceed, and when you get to the place, it says, "you have arrived at your destination.' It does this amazing work through a process of thorough data collection and analysis and is based on an overwhelming amount of evidence. Similarly, embarking on a research project without planning may lead to time-wasting, poor outcomes and feelings of dissatisfaction. In the following sections, we will take you through the research process, selecting a research topic, mapping your research idea, reviewing the literature and developing a research question.

2.1 RESEARCH PROCESS

As shown in Figure 2.1 below, the research process involves eight essential steps of conducting research that is required to achieve the desired goals/aims. The research process is cyclical and starts with some questions or observations and existing scientific knowledge (i.e. literature review), wherein knowledge gaps are identified and used to guide the development of a research topic 1. Next, the specific research question is formulated with the hypotheses stated, and the research design is chosen based on the question/aim. Subsequently, the study is conducted, data is collected, analysed and written up for publication or dissemination to targeted audiences.[1] The final report or publication goes on to add to the existing body of knowledge, and the cycle continues. The first three steps (questions or observations and knowledge, developing the research topic and developing the research question) will be addressed in this chapter. Additionally, detailed steps in reviewing the literature and types of reviews will be explored.

Figure 2.1 The cyclical research process by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence



2.2 IDENTIFYING KNOWLEDGE GAP

The first and foremost step in conducting research is identifying previously unexplored research areas. Choosing an unexplored area in your area of clinical practice or research field will increase the value of your research and your chances of getting the work published. It would be devastating to complete a research project and be unable to publish the study findings because another researcher has already published something similar or be unable to see it applied to practice because some elements are not authentic/realistic and it is not relevant to practice settings. It is therefore important to identify knowledge gaps i.e., problems that have not been addressed before in your field of study or clinical practice, before you embark on choosing a research topic/question.

You may ask the question How do I select a research topic/question? Experienced researchers often have a clear idea of what research topic/question they want to pursue. However, novice researchers, often find it difficult to identify original and innovative research topics. Three major ways of identifying existing research gaps in your field of study include seeking (1) guidance from experienced researchers or clinical practitioners, (2) inspiration from published literature and (3) databases for relevant articles.

1. Guidance from experienced researchers or clinical practitioners: You can discuss questions and issues in your field with experienced researchers or clinical practitioners to seek advice and generate research ideas. Articulating your ideas and knowing what experts are thinking and working on can help you identify areas of your research or identify flaws in your approach.
2. Inspiration from published literature: Read extensively on your topic of interest by consulting relevant and current books and articles. Not only will this help you understand the depth of research that researchers in your field are doing, but it will also give you the opportunity to ask questions that may lead to identifying research gaps.
3. Search databases for relevant articles: You can utilise research databases to analyse research trends in your field. Most of the databases, such as Scopus and Web of Science, cover scholarly literature from almost any discipline and are freely available and easily accessible.

2.3 CHOOSING A RESEARCH TOPIC

Many researchers assume that choosing a topic is a linear process; however, in reality, it is more complex, and the research idea may need to be refined before the topic is finally chosen. Watch the video below that explains the process of choosing a research topic.

Choosing a research idea video by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC ND 4.0 licence

Techniques for finding and choosing a research topic

There are two main approaches to finding and choosing a research topic– rational (logical) and creative (intuitive).[2,3] The creative approach requires techniques such as brainstorming, keeping a record of the ideas, using relevance trees and exploring personal preferences.[3,4] The rational approach, on the other hand, involves techniques such as reviewing the literature to identify knowledge gaps, discussing the ideas with subject experts, peers or stakeholders, using past project titles, scanning the media and identifying one's strengths and interests.[3,4] It is also imperative to engage in critical reflection throughout the process to ensure that the topic is relevant. As a result of this process, the topic may not only be refined but may change substantially. It is important to note that diverse techniques can be used simultaneously or iteratively to decide on a research topic.[3] Figure 2.2 portrays the different techniques.

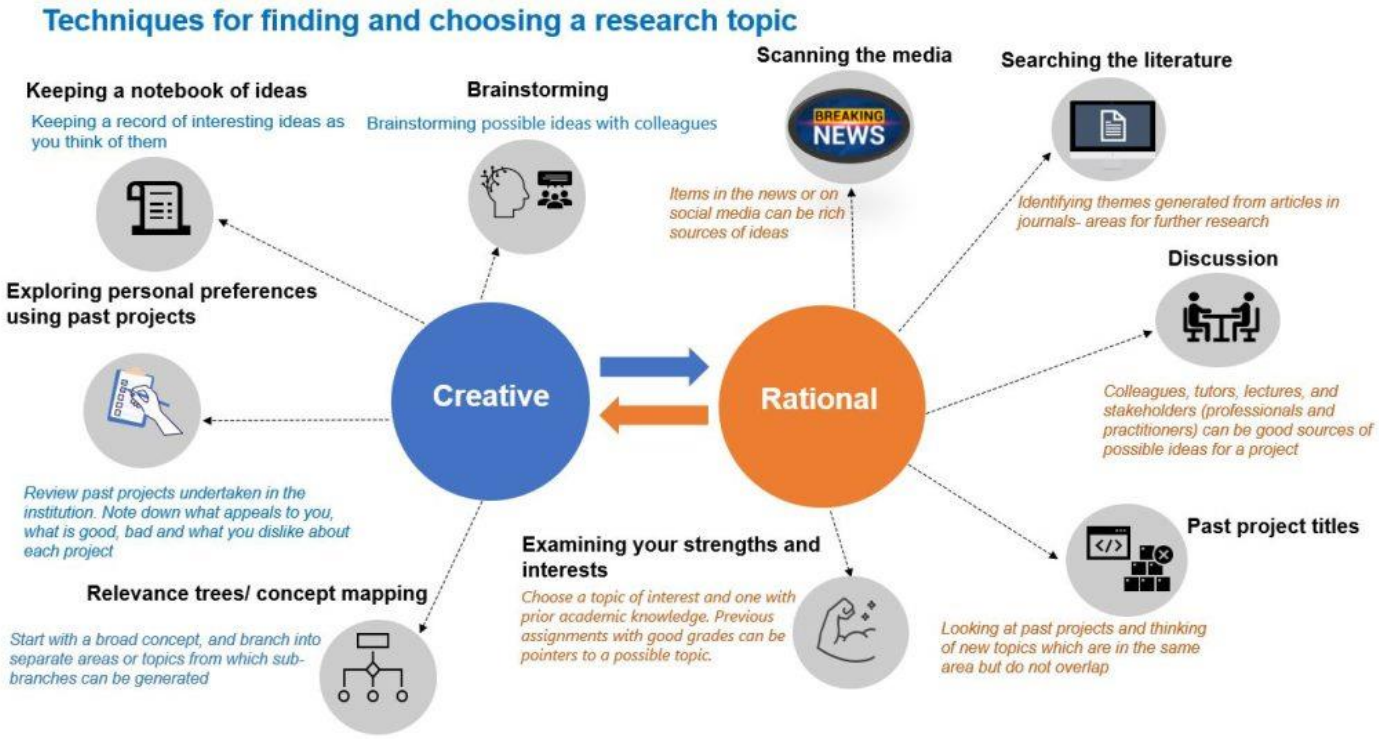


Figure 2.2 Techniques for finding and choosing a research topic by Bunmi Malau-Aduli and Faith Alele. Adapted from Saunders et al. 2003[3] used under a CC BY NC 4.0 licence

Attributes of a good research topic

As a researcher, it is important to ensure that your chosen research topic is of obvious value and benefit, financially viable and within your capabilities and interests.[5] As indicated in Table 2.1, ways of assessing your capability include deciding if the topic is achievable within the time frame, whether the project will be current at completion and whether you have access to the required data.[4] Furthermore, there is a need for the topic to be linked to theory, emphasising the role and importance of literature.[4] This implies that the topic should be set in the context of existing literature, i.e. reading and identifying research already undertaken on that topic to guide the decision-making process about the topic selection. Also, the literature aids the refinement of research ideas and prevents research that repeats what has already been done.[6] The proposed research should provide fresh insight into the topic, the aims and objectives should be clear,[7] and the findings should be of similar value irrespective of the outcome (symmetrical).[4] Finally, the research topic should match the researcher's career goals.[4] While this may not be the case in all instances, it is important to give it considerable thought, especially for those undertaking a dissertation. A checklist of the attributes of a good research topic is listed in Table 2.1 and serves as a guide when choosing a topic.

Table 2.1 Attributes of a good research topic. Adapted from Saunders, et al. 2003 [3]

Capacity: Is it feasible?	Appropriateness: Is it worthwhile?
Is the topic something the researcher is interested in?	Does the topic fit the specifications set by the examining institution and related to the idea given?
Can the researcher develop or obtain the necessary skills within the project time frame?	Is the topic grounded in the literature (linked to theory)?
Is the topic achievable in the time available?	Are the research aims and objectives clearly stated?
Will the topic/project remain current at the end of the research?	Will the topic provide new insights (originality)?
Is the topic/project financially viable?	Is the topic likely to have symmetry of potential outcomes?
Will it be easy and feasible to assess and acquire data for the topic?	Does the topic match the researcher's career goals?
	Will the topic provide useful knowledge for application in clinical practice?

Refining the research topic/idea

Remember that a research idea can be generated using rational and/or creative techniques. However, at the onset, the developed idea may be too broad or too specific and may need to be refined. Refining a research idea involves the steps outlined in Figure 2.3. First, a research topic is picked, and the topic is tested by reading the literature. If the topic is too broad, it needs to be made more focused, and if it is too specific, it needs to be broadened. The literature search and discussion with subject experts could be useful in refining the topic.[2]

Figure 2.3 Refining the research idea by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

A useful way of refining the research idea/topic is to use a concept map based on the findings from the literature or discussions to identify contextual factors or areas related to the topic.[3] Let us return to our previous example of obesity as your research topic which was depicted in the video. A concept map that utilized the 5Ws and H (who, what, where, when, why and how) questions is presented in Figure 2.4 to facilitate in-depth analysis and refinement of the research topic. It is important to note that concept maps can be complex as each theme can be branched into further subthemes.

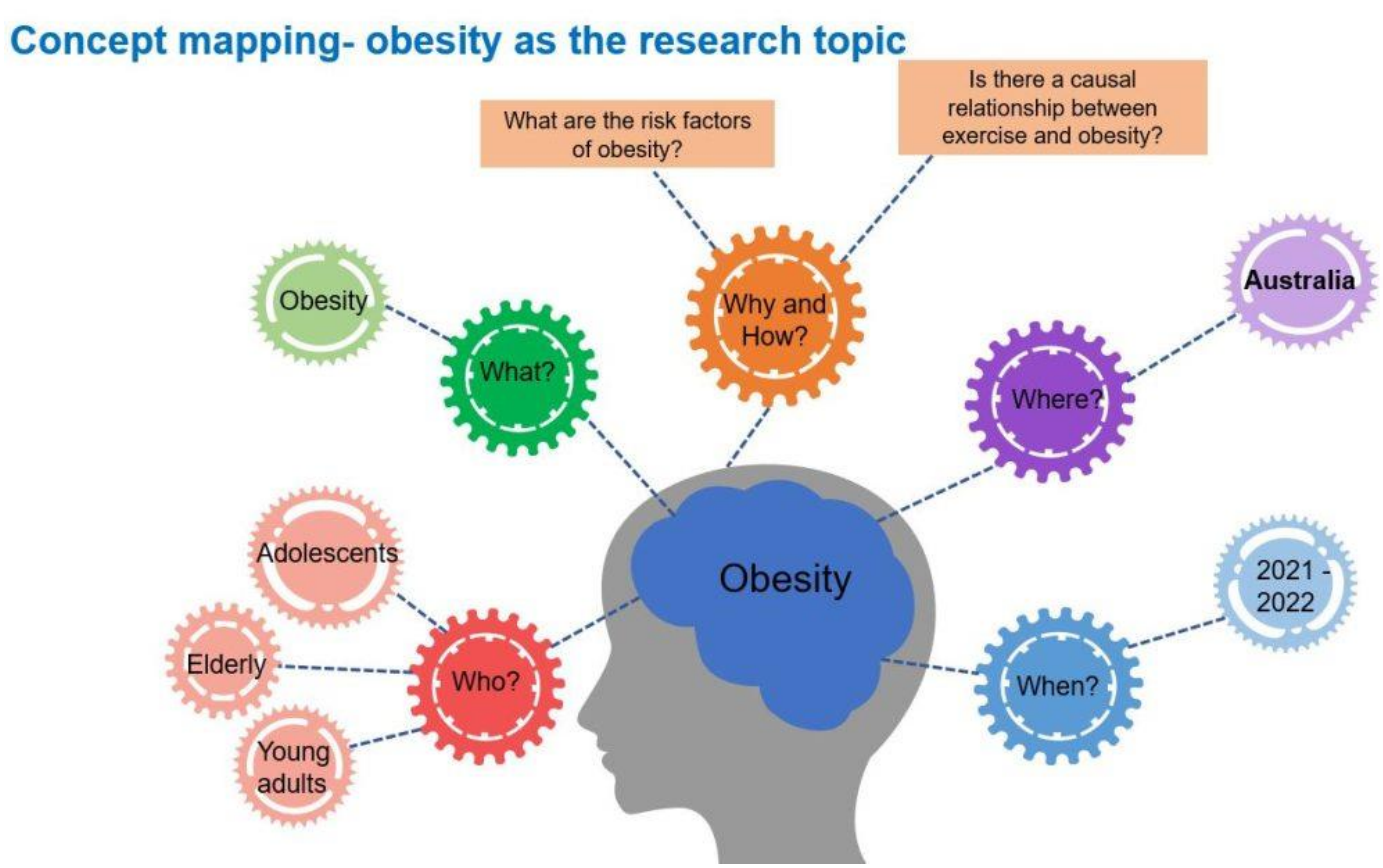


Figure 2.4 Concept mapping obesity as a research topic by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

The refined topic can be further tested by searching the literature to ensure that the idea is novel and has not been previously answered. The Delphi technique is an alternative technique that could also be used to refine the topic and generate possible research questions.[8] The Delphi technique entails selecting a more focused research idea via contributions from a group of people who are either working on or interested in the research topic.[8] The Delphi consists of four distinct phases. In the first phase, participants can provide whatever information they deem pertinent, which explores the topic under investigation. The second stage is ascertaining how the entire group perceives the topic/idea.[8] The third step is utilised to investigate any substantial disputes and identify the root causes of any identified differences. A final assessment of all the information acquired is done in the fourth step.[8]

2.4 DEVELOPING A RESEARCH QUESTION

Once the research topic has been decided, the next step is to formulate the research question(s) (Figure 2.1). The research question highlights the issue that has to be investigated and directs the methodology. It also results in the development of a testable and appropriate hypothesis. It is thought that high-quality research results from well-crafted research questions.[9] Coming up with good research questions is something that most novice researchers find challenging. A valid tool that is useful in formulating a good research question is the PICOT framework which is commonly used in quantitative research.[6] To use this framework, you need to consider the population of interest (P), the intervention (I) under investigation, the control or comparison group (C), the outcome (O), and the time frame (T) during which the study will take place (see Figure 2.5).[6]

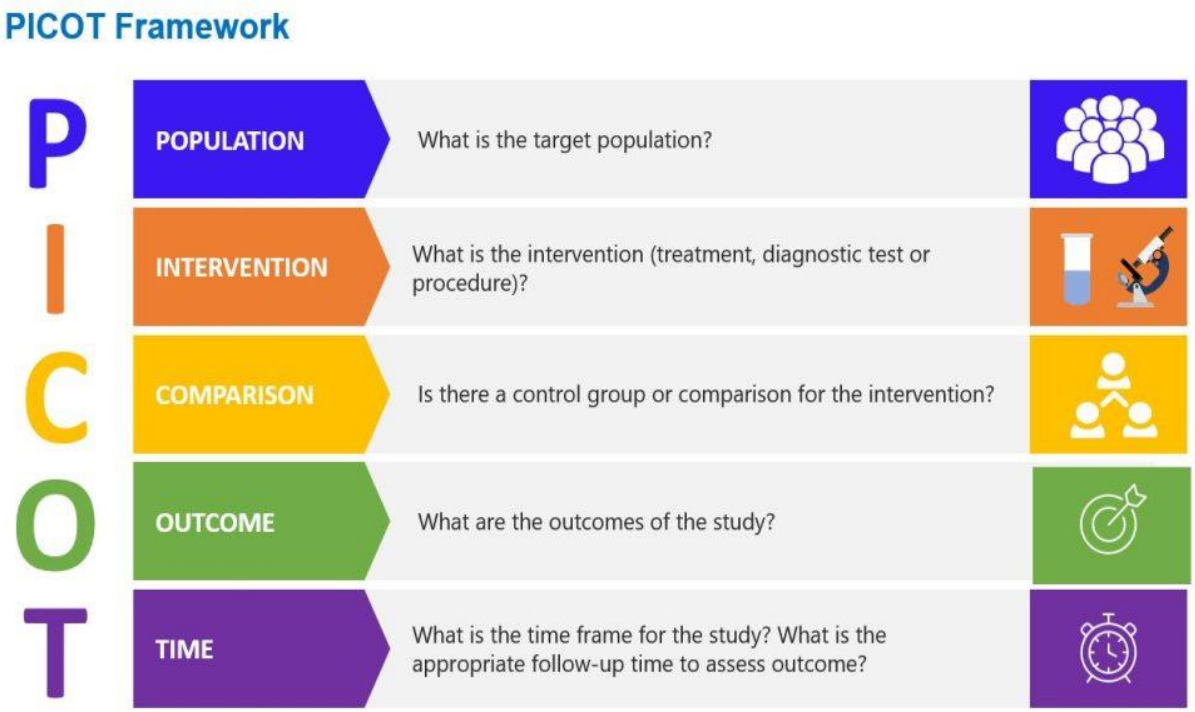


Figure 2.5 PICOT Framework by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

In addition, the framework is valuable when developing and stating a research hypothesis driven by the research question.[6] A hypothesis is a foundation and logical construct between a research problem and its solution, and it expresses a possible answer to a research question.[10] The research question serves as the basis for the development of the research hypothesis, which is then summarised in a way that establishes the basis for testing, statistical analysis, and, ultimately, the significance of the study (30). A good hypothesis is usually founded on a good research question. There are two types of

research hypotheses – conceptual research hypothesis and operational research hypothesis.[10] The conceptual research hypothesis is a broad or general statement about a research problem, while the operational hypothesis is a more specific statement that provides a detailed description of how the variables in the study will be measured, and predicts how they will be related to one another.[10] Thus, the operational hypothesis is a testable statement that is derived from the conceptual hypothesis. The example below in Figure 2.6 and Box 2.1 shows how the PICOT framework is used to develop a research question and hypotheses.

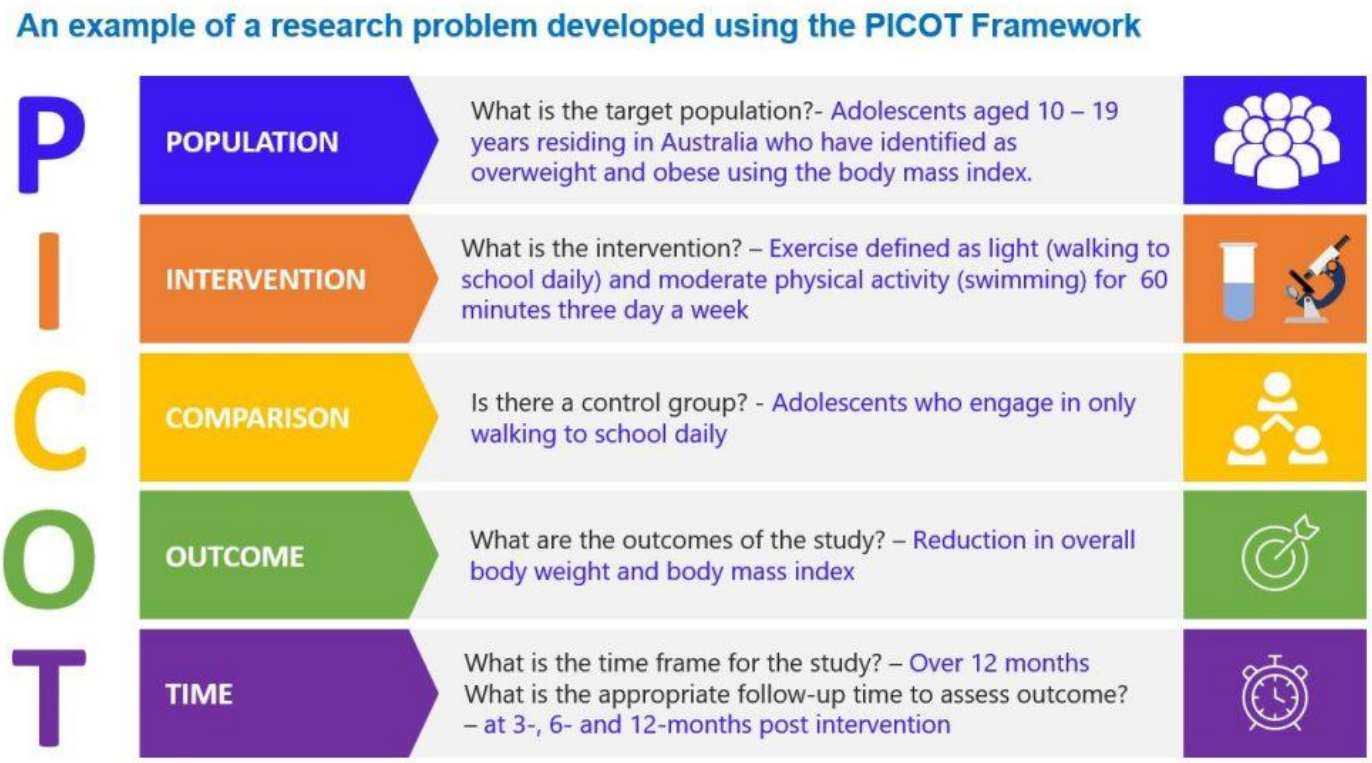


Figure 2.6 Example of a research problem developed using PICOT Framework by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Box 2.1 Framing a research question, conceptual and operational hypothesis

Research Question

Is frequent and regular exercise associated with a decrease in body weight and body mass index among overweight and obese Australian adolescents?

Conceptual Hypothesis

Frequent and regular exercise reduces obesity in Australian adolescents

Operational Hypothesis

Frequent and regular exercise, defined as light exercise (walking to school daily) and moderate exercise (swimming for 60 minutes three days a week), will reduce overall body weight measured in kilograms and body mass index in overweight and obese Australian adolescents aged 10 to 19 years compared to only light exercise (walking to school) only.

Characteristics of a good research question

A good research question has the following qualities: it is Feasible, Interesting, Novel, Ethical, and Relevant (FINER).[11]

*Feasible: b*eing feasible indicates that it is practical for the investigator to carry out.[11] This refers to the distribution of appropriate resources (including a budget), sufficient research design, readily available skills and information, and an acceptable time limit.[12] Participants must be realistically recruitable and accurately representative of the relevant population if they are to be chosen for the study.[12] The research question should be connected to the available observations, phenomena, indicators, or variables.[13]

*Interesting: t*he presentation of the research questions and the story that may be told about the research field through investigation and analysis are two important aspects of what makes research

intriguing.[12] It is also a good idea to check if the research question is intriguing to others.[11] If research does not address a question of interest, it will have no influence or impact.[11] While a research study may be interesting, other contextual factors, such as the way the issue is presented, the context of the subject, the target audience, and the reader's expectations, may impact whether the findings will be considered intriguing or not.[14]

*Novel: n*ovelty and relevance are the most important criteria for any research project's success.[12] Good research adds fresh knowledge.[11] A study that essentially restates what has already been proven is not worth the time, money, and effort and is not likely to be published.[11] Novelty can range in breadth from moderately unique to extremely novel, and it may involve, among other things, contesting preexisting theories, positing new ones, or both.[12] Novelty also has to do with pointing out specific gaps in the field's current ideas or methods for looking at phenomena or with the extension of theories or results to new subfields.[12] By carefully reading the literature and consulting with specialists who are familiar with ongoing unpublished research, one can assess the uniqueness of a proposed study.[11]

*Ethical: r*esearch must be ethical; thus, research questions must not result in unethical conduct.[11] The research should be conducted in a way that reduces the risk of harm to participants, protects their privacy and confidentiality, and gives them the option to withdraw from the study.[12] It is important to obtain approval from the institutional review board before beginning research.[11] Further details on ethical considerations are presented in chapter 6.

*Relevant: r*elevant topics are those that are of priority at a given time in the research community and have an impact on upcoming research directions.[12] Relevant questions have a clear target audience in the community, and the answers to their inquiries have an impact on ongoing research projects.[12] Thus, it is crucial to consider the potential outcomes and how each one might increase scientific understanding, impact clinical recommendations and public health policies, or serve as a direction for future study.[11]

Use the Padlet below to develop a research question of interest to you.

- Think of a research topic that you are passionate about.
- Do you know if this problem has been researched before? If yes, what are the gaps?
- Articulate on paper a research gap/problem (from this topic) that you would like to investigate.
- Phrase the problem as a research question and post it on the Padlet below.

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2.5 REVIEWING THE LITERATURE

It is very important to have a thorough understanding of published literature in an area of study because strong scholarship is a prerequisite for sound research.[11] According to Fink (2019), a literature review is a systematic, explicit, and reproducible procedure for identifying, evaluating and synthesising the existing body of recorded and completed work produced by researchers.[15] The role of literature searches and reviews was discussed and highlighted as one of the ways to develop a research idea and to identify gaps that could lead to the development of a research question.[16] A novice researcher should critically review published articles and undertake a thorough search of the published literature in the fields relevant to the research issue.[16] Performing a search of the literature requires an understanding of the different types of research literature.

Types of research literature

There are two main types of literature- primary research literature and secondary research literature. Literature that reports primary research is original research published in peer-reviewed journals. These could include case studies, case series, cross-sectional, cohort, case-control and experimental studies. Primary literature also includes reports, congress papers, dissertations and preprints. This type of research could be identified from databases such as Medline/PubMed, CINAHL (Cumulative Index of Nursing and Allied Health Literature), Emcare, Embase, Google Scholar, Scopus, Web of Science, or PsycINFO. The other type, which is secondary literature, reports findings synthesised from primary sources and includes systematic reviews (review of primary research), meta-analysis (a statistical analysis that combines the results of multiple quantitative studies) or meta-synthesis (synthesis of multiple qualitative studies).

Types of literature reviews

A literature review is a critical evaluation and analysis of existing literature on a particular topic or research question. Literature reviews can be broadly grouped into seven families – traditional literature reviews, systematic reviews, review of reviews, rapid reviews, qualitative systematic reviews, mixed methods reviews and purpose-specific reviews. While this section is not intended to discuss the review families, we have provided a summary description of each review family and a diagram (Figure 2.7) that depicts the subcategories. For a more detailed read on these reviews, see the article “meeting the review family: exploring review types and associated information retrieval requirements” published by Sutton et al 2019.[17]

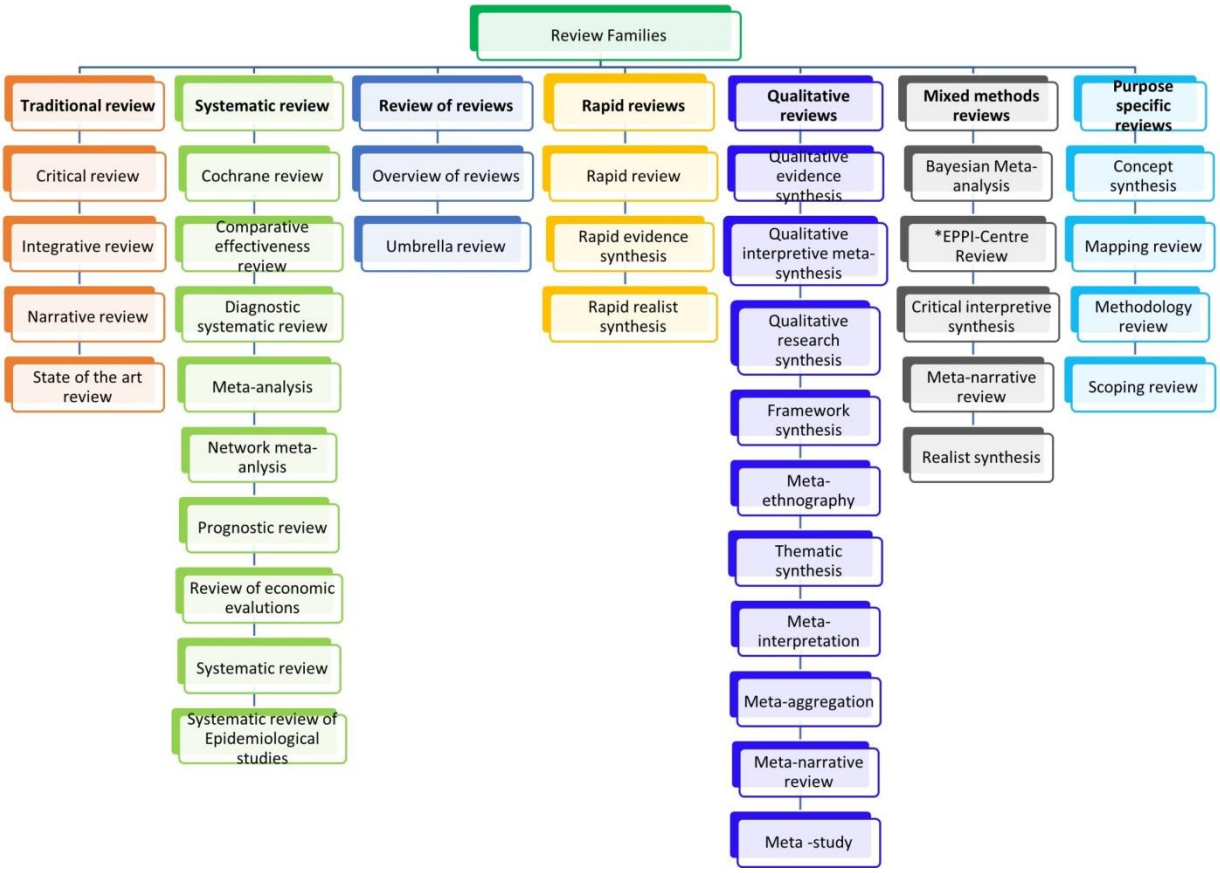

Figure 2.7 Family of reviews by Bunmi Malau-Aduli and Faith Alele. Adapted from Sutton et al. 2019 [17], used under a CC BY NC 4.0 licence. * EPPI – The Evidence for Policy and Practice Information and Coordinating Centre, Institute of Education

A detailed description of each major type of review is presented below.

2.6 CONDUCTING AN EFFECTIVE LITERATURE SEARCH

An important step in preparing a literature review is doing an effective literature search; while it is important, its significance may be overlooked.[23] The internet provides quick access to an abundance of primary, secondary, and tertiary medical literature, which can be assessed via online journals, books, dictionaries, indexes and databases, giving users access to a wider range of individualised and structured educational opportunities.[24] Medical literature can be found online using search engines like Google, Google Scholar, Yahoo, etc., and databases like MEDLINE, PubMed, CINAHL, Emcare, EMBASE, PsycINFO, SCOPUS, Web of Science, etc.[24] Depending on your study area, there are many databases and search engines. The ones above are the typical ones in health sciences. The two video clips below show details on how to search Medline and CINAHL.

For a more detailed explanation of systematic reviews, watch the video below (3:23 mins) which explains why systematic reviews are important and how they are done. This includes an explanation of how the effects of interventions are compared in order to provide evidence.

Use the research question you developed in section 2.4 to complete the tasks below. Complete Task 1 on the Padlet.

- **Task 1:** Decide on a research topic/research question and list four (4) terms associated with the topic that may be used as search terms.
- **Task 2:** Conduct a literature search around your topic using search terms across two (2) databases. List the number of articles identified, then remove duplicates. Review at least five (5) abstracts from these articles to determine their usefulness.

2.7 CONCLUSION

In this chapter, you have learned about the processes involved in planning a research project. The process of research involves identifying a research problem or question, conducting a literature review to understand what is already known about the topic, formulating a hypothesis or research question, designing a study to test the hypothesis or answer the research question, collecting and analysing data, and finally drawing conclusions and sharing the findings with the wider community.

As indicated in the opening scenario, just like a GPS, a research plan is essential for a successful research project. Planning helps to steer the project in the right direction, keep it on track, and ultimately achieve the desired outcome. Here are some of the reasons presented in this chapter about why planning is important in research:

- Clarifies the research question: A clear research question is critical for the success of a research project. Planning helps to define the research question and identify the variables that need to be measured. This ensures that the research is focused and specific.

- Establishes a research design: A research design outlines the methods that will be used to collect and analyse data. Planning helps to establish a research design that is appropriate for the research question and ensures that data will be collected and analysed in a way that is valid and reliable.
- Identifies potential challenges: Planning helps to identify potential challenges and obstacles that may arise during the research project. This allows researchers to anticipate these challenges and take steps to address them.
- Maximizes resources: Planning helps to maximize resources, including time, funding, and personnel. By having a clear plan, researchers can allocate resources more effectively and efficiently.
- Provides a framework for evaluation: Planning provides a framework for evaluating the success of the research project. By having clear objectives and a plan for achieving them, researchers can assess the success of the project and identify areas for improvement.

In conclusion, just like a GPS is crucial for finding our way during a road trip, planning is essential for the success of a research project. It helps to define the research question, establish a research design, identify potential challenges, maximize resources, and provide a framework for evaluation. By taking the time to plan, researchers can increase the likelihood of a successful outcome and avoid feelings of dissatisfaction.

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NAVIGATING QUANTITATIVE RESEARCH

"Nothing has such power to broaden the mind as the ability to investigate systematically and truly all that comes under thy observation in life"- Marcus Aurelius

In this chapter you will learn about:

- quantitative research designs
- methods of data collection
- sampling techniques and sample size calculation for cross-sectional studies
- designing a survey
- quantitative data analysis.

Opening Scenario

Jaden is a six-year-old curious kid who loves exploring the world around him. One day, while playing in his room, the light bulb suddenly went out, leaving the room in darkness. Jaden didn't know what had happened, and he asked his mother to come and fix it. Jaden's mother noticed that the light bulb had blown out and decided to use this opportunity to teach her son how to determine whether a light bulb had blown. She explained to Jaden that when a light bulb blows, it means that the filament inside the bulb has burned out, and it won't work anymore. To help Jaden understand this concept, his mother showed him a new light bulb and then opened a blown one. She pointed out the differences in the filaments and how they looked, explaining that the burnt-out filament would have dark spots or break. Jaden was fascinated by what he had learned and started to investigate the light bulbs in other rooms. He wanted to see if he could spot a blown bulb by looking for the dark spot or break in the filament. As Jaden continued to explore and investigate the world around him, his mind broadened, his curiosity grew, and he began to ask more questions, try new things, and make connections between the things he learned. Jaden's mother was happy to see her son's interest in investigating systematically and truly all that

came under his observation. This reminded her of Marcus Aurelius' quote, "Nothing has such power to broaden the mind as the ability to investigate systematically and truly all that comes under thy observation in life". She knew that this skill would serve Jaden well throughout his life and open many doors for him.

3.1 WHAT IS QUANTITATIVE RESEARCH?

Quantitative research is a research method that uses numerical data and statistical analysis to study phenomena. [1] Quantitative research plays an important role in scientific inquiry by providing a rigorous, objective, systematic process using numerical data to test relationships and examine cause-and-effect associations between variables. [1, 2] The goal is to make generalisations about a population (extrapolate findings from the sample to the general population). [2] The data and variables are predetermined and measured as consistently and accurately as possible, and statistical analysis is used to evaluate the outcomes. [2] Quantitative research is based on the scientific method, wherein deductive reductionist reasoning is used to formulate hypotheses about a particular phenomenon.

3.2 QUANTITATIVE RESEARCH DESIGNS

Quantitative research study designs can be broadly classified into two main groups (observational and experimental) depending on if an intervention is assigned. If an intervention is assigned, then an experimental study design will be considered; however, if no intervention is planned or assigned, then an observational study will be conducted. [3] These broad classes are further subdivided into specific study designs, as shown in Figure 3.1. In practice, quantitative studies usually begin simply as descriptive studies, which could subsequently be progressed to more complex analytic studies and then to experimental studies where appropriate.

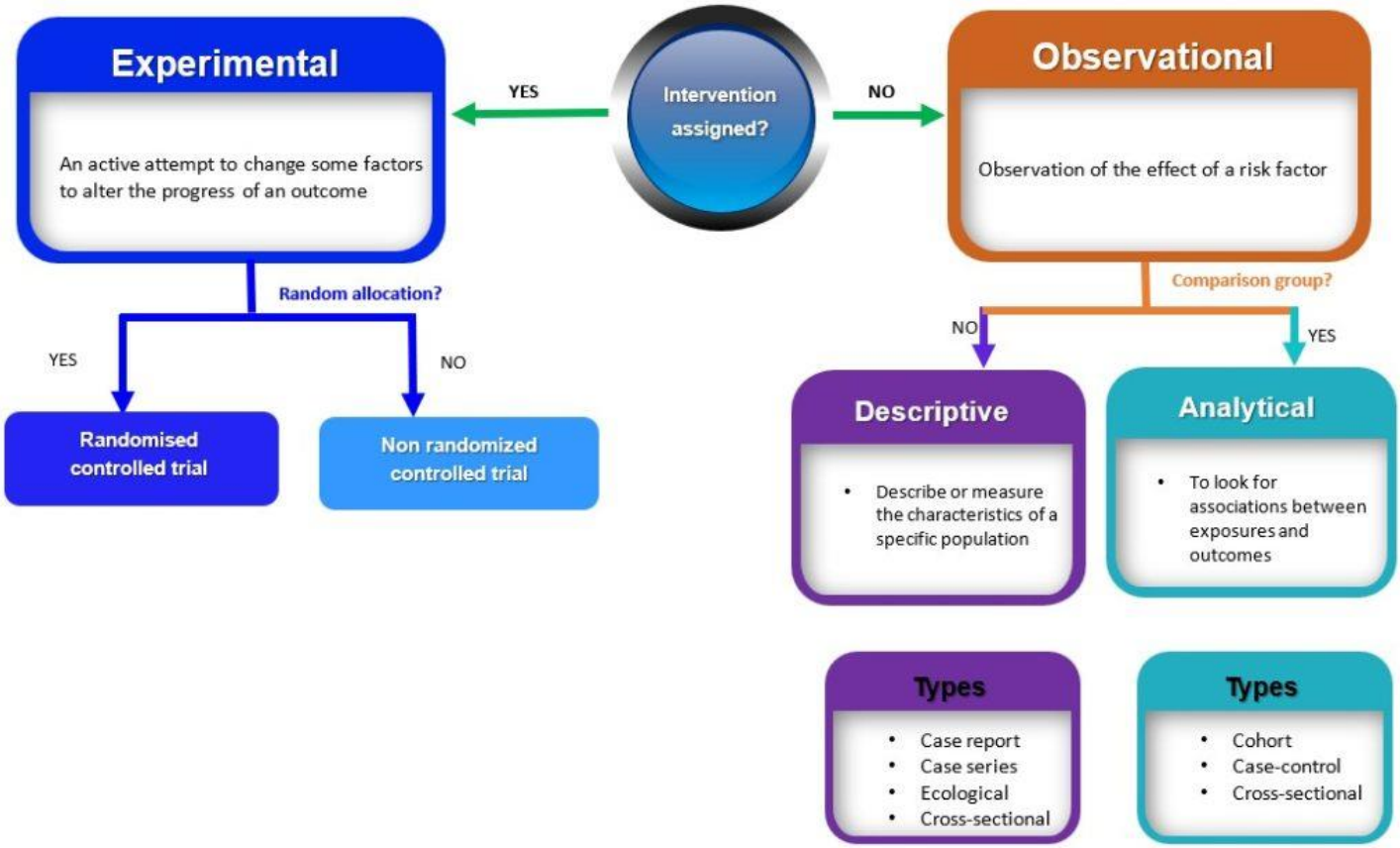

Figure 3.1 Algorithm for classification of study designs by Bunmi Malau-Aduli and Faith Alele. Adapted from Grimes and Schulz 2002, used under a CC BY NC 4.0 licence

Observational studies

Observational studies are research designs that involve observing and measuring the characteristics of a sample or population without intervening, altering or manipulating any variables (Figure 3.1). [3] Observational studies can be further subdivided into descriptive and analytic studies. [3]

Descriptive observational studies

Descriptive studies are research designs that describe or measure the characteristics of a specific population or phenomenon. These characteristics include descriptions related to the phenomenon under investigation, the people involved, the place, and the time. [4] These study designs are typically non-experimental and do not involve manipulating variables; rather, they rely on the collection and analysis of numerical data to draw conclusions. Examples of descriptive studies include case reports, case series, ecological studies and cross-sectional (prevalence studies). [2] These are discussed below

- ***Case Reports and Case series***

Case reports and case series are both types of descriptive studies in research. A case report is a detailed account of the medical history, diagnosis, treatment, and outcome of a single patient. [5] On the other hand, case series is a collection of cases with similar clinical features. [5] Case series are frequently used to explain the natural history of a disease, the clinical characteristics, and the health outcomes for a group of patients who underwent a certain treatment. Case series typically involve a larger number of patients than case reports. [5] Both case reports and case series are used to illustrate unusual or atypical features found in patients in practice. [5] In a typical, real-world clinical situation, they are both used to describe the clinical characteristics and outcomes of individual patients or a group of patients with a particular condition. These studies have the potential to generate new research questions and ideas. [5] However, there are drawbacks to both case reports and case series, such as the absence of control groups and the potential for bias. Yet, they can be useful sources of clinical data, particularly when researching uncommon or recently discovered illnesses. [5] An example of a case report is the study by van Tulleken, Tipton and Haper, 2018 which showed that open-water swimming was used as a treatment for major depressive disorder for a 24-year-old female patient.[6] Weekly open (cold) water swimming was trialled, leading to an immediate improvement in mood following each swim. A sustained and gradual reduction in symptoms of depression, and consequently a reduction in, and cessation of, medication was observed.[6] An example of a case series is the article by Chen et al, 2020 which described the epidemiology and clinical characteristics of COVID-19 infection among 12 confirmed cases in Jilin Province, China.[7]

- ***Ecological studies***

Ecological studies examine the relationship between exposure and outcome at the population level. Unlike other epidemiological studies focusing on individual-level data, ecological studies use aggregate data to investigate the relationship between exposure and outcome of interest. [8] In ecological studies, data on prevalence and the degree of exposure to a given risk factor within a population are typically collected and analysed to see if exposure and results are related. [8] Ecological studies shed light on the total burden of disease or health-related events within a population and assist in the identification of potential risk factors that might increase the incidence of disease/event. However, these studies cannot prove causation or take into account characteristics at the individual level that can influence the connection between exposure and result. This implies that ecological findings cannot be interpreted and extrapolated to individuals. [9] For example, the association between urbanisation and Type 2 Diabetes was investigated at the country level, and the role of intermediate

variables (physical inactivity, sugar consumption and obesity) was examined. One of the key findings of the study showed that in high-income countries (HIC), physical inactivity and obesity were the main determinants of T2D prevalence.[10] However, it will be wrong to infer that people who are physically inactive and obese in HIC have a higher risk of T2D.

- ***Cross-sectional Descriptive (Prevalence) studies***

  A cross-sectional study is an observational study in which the researcher collects data on a group of participants at a single point in time. [11] The goal is to describe the characteristics of the group or to explore relationships between variables. Cross-sectional studies can be either descriptive or analytical (Figure 3.2). [11] Descriptive cross-sectional studies are also known as prevalence studies measuring the proportions of health events or conditions in a given population. [11] Although analytical cross-sectional studies also measure prevalence, however, the relationship between the outcomes and other variables, such as risk factors, is also assessed. [12] The main strength of cross-sectional studies is that they are quick and cost-effective. However, they cannot establish causality and may be vulnerable to bias and confounding (*these concepts will be discussed further later in this chapter under "avoiding error in quantitative research)*. An example of a cross-sectional study is the study by Kim et al., 2020 which examined burnout and job stress among physical and occupational therapists in various Korean hospital settings. [13] Findings of the study showed that burnout and work-related stress differed significantly based on several factors, with hospital size, gender, and age as the main contributory factors. The more vulnerable group consisted of female therapists in their 20s at small- or medium-sized hospitals with lower scores for quality of life. [13]

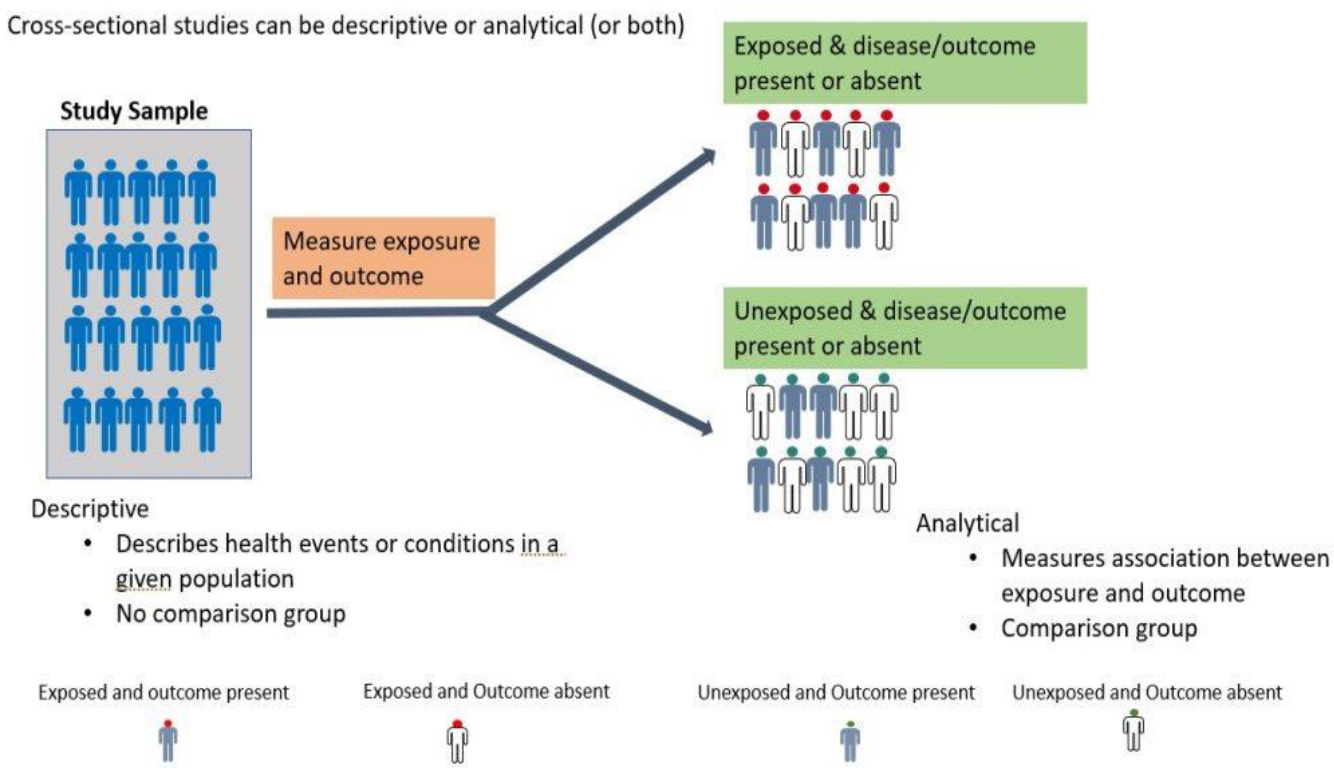

Figure 3.2 Cross-sectional studies by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Analytical Observational studies

Analytical observational studies aim to establish an association between exposure and outcome and identify causes of disease (causal relationship). [14] Analytical observational studies include analytical cross-sectional (*discussed above*), case-control and cohort studies. [14] This research method could be prospective(cohort study) or retrospective (case-control study), depending on the direction of the enquiry. [14]

- ***Case-control studies***

A case-control study is a retrospective study in which the researcher compares a group of individuals with a specific outcome (cases) to a group of individuals without that outcome (controls) to identify factors associated with the outcome. [15] As shown in Figure 3.3 below, the cases and controls are recruited and asked questions retrospectively (going back in time) about possible risk factors for the outcome under investigation. A case-control study is relatively efficient in terms of time, money and effort, suited for rare diseases or outcomes with a long latent period, and can examine multiple risk factors. [15] For example, before the cause of lung cancer, was established, a case-control study was conducted by British researchers Richard Doll and Bradford Hill in 1950. [16] Subjects with lung cancer were compared with those who did not have lung cancer, and details about their smoking habits were obtained. [16] The findings from this initial study showed that cancer patients were more frequent and heavy smokers. [16] Over the years, more evidence has been generated implicating tobacco as a

significant cause of lung cancer. [17, 18] Case-control studies are, therefore, useful for examining rare outcomes and can be conducted more quickly and with fewer resources than other study designs. Nonetheless, it should be noted that case-control studies are susceptible to bias in selecting cases and controls and may not be representative of the overall population. [15]

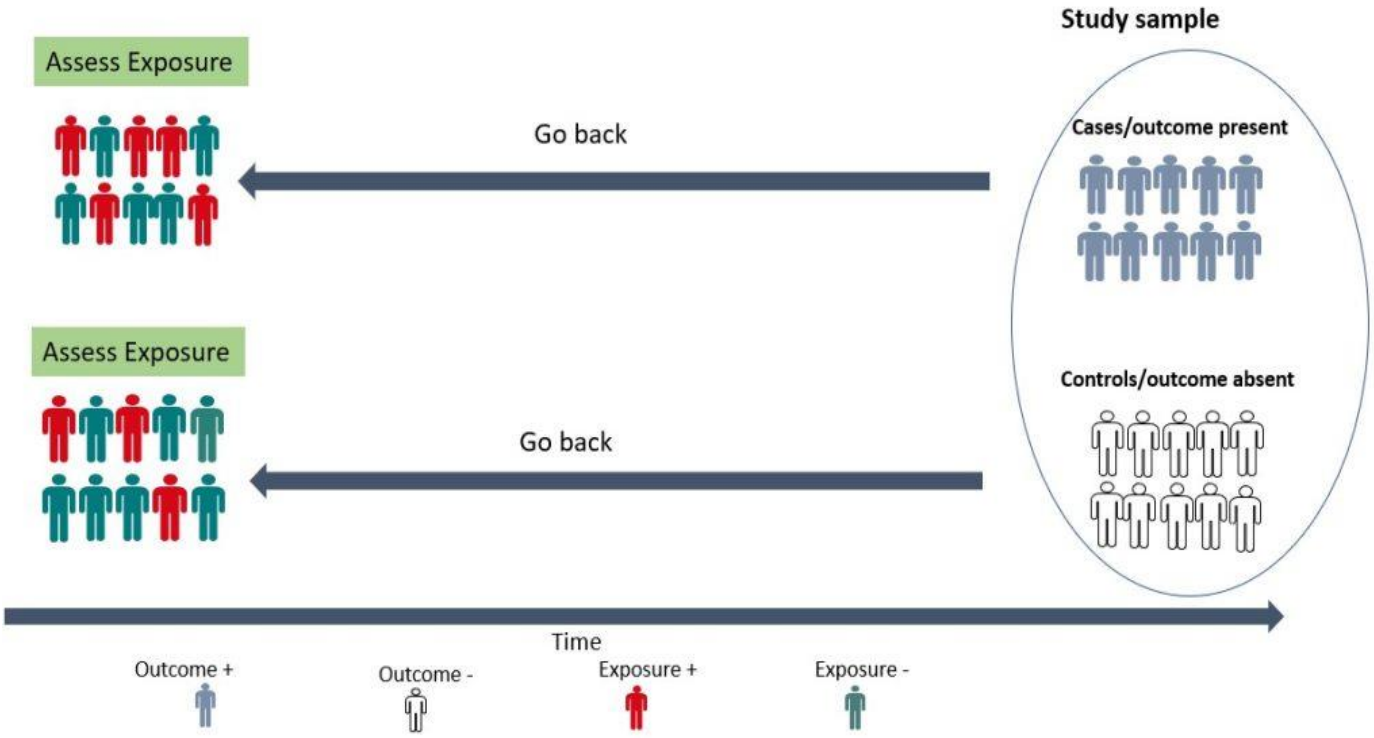

Figure 3.3 Case-Control studies by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- ***Cohort Study***

Cohort studies are longitudinal studies in which the researcher follows a group of individuals who share a common characteristic (e.g., age, occupation) over time to monitor the occurrence of a particular health outcome. [19] The study begins with the selection of a group of individuals who are initially free of the disease or health outcome of interest (the "cohort"). The cohort is then divided into two or more groups based on their level of exposure (for example, those who have been exposed to a certain risk factor and those who have not). [19] Participants are then followed up, and their health outcomes are tracked over time. The incidence of the health outcome is compared between exposed and non-exposed groups, and the relationship between exposure and the outcome is quantified using statistical methods. [19] Cohort studies can be prospective or retrospective (Figure 3.4). [20] In a prospective cohort study, the researchers plan the study so that participants are enrolled at the start of the study and followed over time. [20, 21] In a retrospective cohort study, data on exposure and outcome are collected from existing records or databases. The researchers go back in time (via available records) to find a cohort that was initially healthy and "at risk" and assess each participant's exposure status at the start of the observation period. [20, 21] Cohort studies provide an understanding of disease

risk factors based on findings in thousands of individuals over many years and are the foundation of epidemiological research. [19] They are useful for investigating the natural history of a disease, identifying risk factors for a disease, providing strong evidence for causality and estimating the incidence of a disease or health outcome in a population. However, they can be expensive and time-consuming to conduct. [15] An example of a cohort study is the study by Watts et al, 2015 which investigated whether the communication and language skills of children who have a history of stuttering are different from children who do not have a history of stuttering at ages 2–5 years. [22] The findings revealed that children with a history of stuttering, as a group, demonstrated higher scores on early communication and language measures compared to their fluent peers. According to the authors, clinicians can be reassured by the finding that, on average, children who stutter have early communication and language skills that meet developmental expectations. [22]

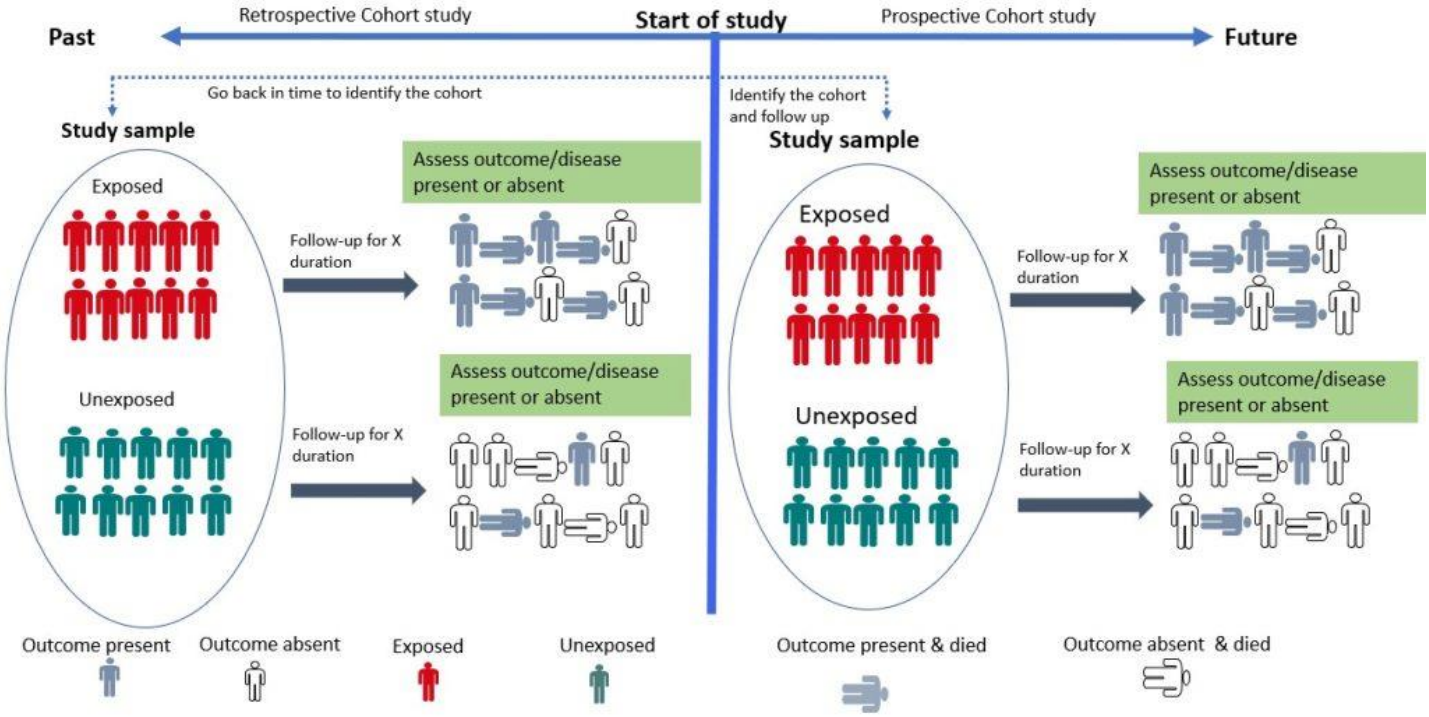

Figure 3.4 Cohort Studies by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Experimental Study Designs (Interventional studies)

Experimental studies involve manipulating one or more variables in order to measure their effects on one or more outcomes. [23] In this type of study, the researcher assigns individuals to two or more groups that receive or do not receive the intervention. Well-designed and conducted interventional studies are used to establish cause-and-effect relationships between variables. [23] Experimental studies can be broadly classified into two – randomised controlled trials and non-randomised controlled trials. [23] These study designs are discussed below:

- ***Randomised Controlled Trial***
- Randomised controlled trials (RCTs) are experimental studies in which participants are randomly assigned to the intervention or control arm of the study. [23] The experimental group receives the intervention, while the control group does not (Figure 3.5). RCTs involve random allocation (not by choice of the participants or investigators) of participants to a control or intervention group (Figure 3.5). [24] Randomization or random allocation minimises bias and offers a rigorous method to analyse cause-and-effect links between an intervention and outcome. [24] Randomization balances participant characteristics (both observed and unobserved) between the groups. [24] This is so that any differences in results can be attributed to the research intervention. [24] The most basic form of randomisation is allocating treatment by tossing a coin. Other methods include using statistical software to generate random number tables and assigning participants by simple randomisation or allocating them sequentially using numbered opaque envelopes containing treatment information. [25] This is why RCTs are often considered the gold standard in research methodology. [24] While RCTs are effective in establishing causality, they are not without limitations. RCTs are expensive to conduct and time-consuming. In addition, ethical considerations may limit the types of interventions that can be tested in RCTs. They may also not be appropriate for rare events or diseases and may not always reflect real-world situations, limiting their application in clinical practice. [24] An example of a randomised controlled trial is the study by Shebib et al., 2019 which investigated the effect of a 12-week digital care program (DCP) on improving lower-back pain. The treatment group (DCP) received the 12-week DCP, consisting of sensor-guided exercise therapy, education, cognitive behavioural therapy, team and individual behavioural coaching, activity tracking, and symptom tracking – all administered remotely via an app. [26] While the control group received three digital education articles only. The findings of the study showed that the DCP resulted in improved health outcomes compared to treatment-as-usual and has the potential to scale personalised evidence-based non-invasive treatment for patients with lower-back pain. [26]

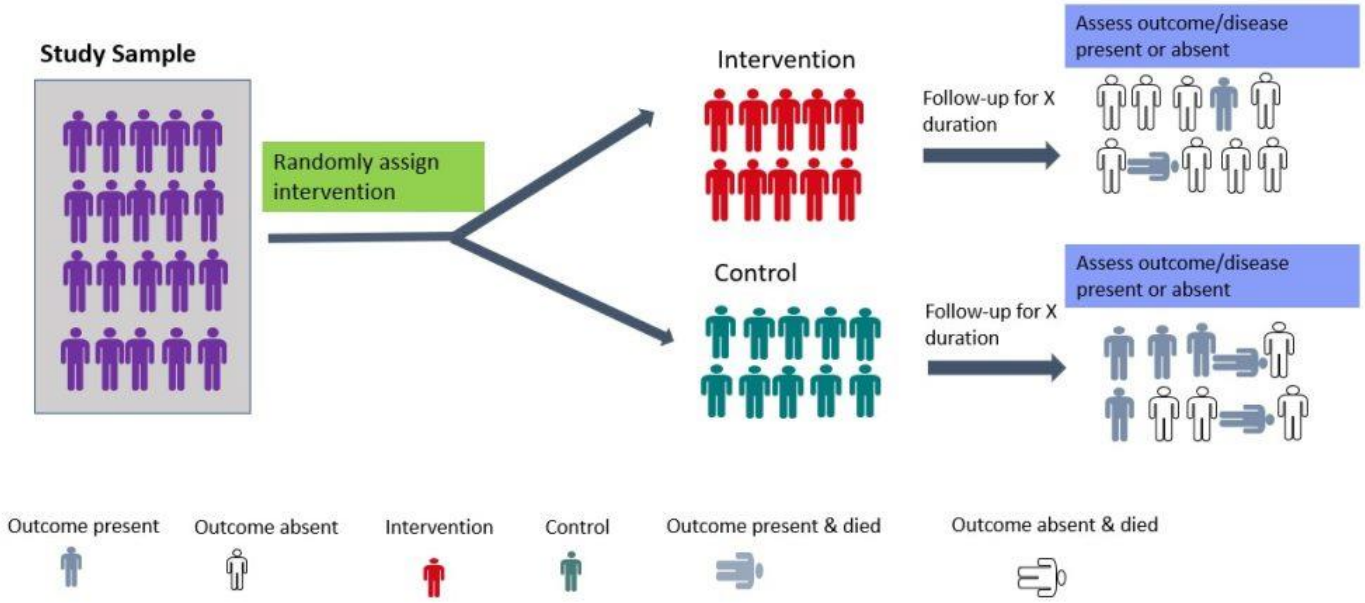

Figure 3.5 Schematic of experimental studies- randomised control trials by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- ***Non-randomised controlled design (Quasi-experimental)***

Non-randomised controlled trial (non-RCT) designs are used where randomisation is impossible or difficult to achieve. This type of study design requires allocation of the exposure/intervention by the researcher. [23] In some clinical settings, it is impossible to randomise or blind participants. In such cases, non-randomised designs are employed. [27] Examples include pre-posttest design (with or without controls) and interrupted time series. [27, 28] For the pre-posttest design that involves a control group, participants (subjects) are allocated to intervention or control groups (without randomisation) by the researcher. [28] On the other hand, it could be a single pre-posttest design study where all subjects are assessed at baseline, the intervention is given, and the subjects are re-assessed post-intervention. [28] An example of this type of study was reported by Lamont and Brunero (2018), who examined the effect of a workplace violence training program for generalist nurses in the acute hospital setting. The authors found a statistically significant increase in behaviour intention scores and overall confidence in coping with patient aggression post-test. [29] Another type of non-RCT study is the interrupted time series (ITS) in which data are gathered before and after intervention at various evenly spaced time points (such as weekly, monthly, or yearly). [30] Thus, it is crucial to take note of the precise moment an intervention occurred. The primary goal of an interrupted time series is to determine whether the data pattern observed post-intervention differs from that noted prior. [30] Several ITS were conducted to investigate the effectiveness of the different prevention strategies (such as lockdown and border closure) used during the COVID pandemic. [31, 32] Although non-RCT may be more feasible to RCTs, they are more prone to bias than RCTs due to the lack of randomisation and may not be able to control for all the variables that might affect the outcome. [23]

- ***Hierarchy of Evidence***

While each study design has its unique characteristics and strengths, they are not without weaknesses (as already discussed) that impact the accuracy of the results and research evidence they provide. The hierarchy of evidence is a framework used to rank the evidence provided by different study designs in research evaluating healthcare interventions with respect to the strength of the presented results (i.e., validity and reliability of the findings). [33] Study designs can be ranked in terms of their ability to provide valid evidence on the effectiveness (intervention achieves the intended outcomes), appropriateness (impact of the intervention from the perspective of its recipient) and feasibility (intervention is implementable) of the research results they provide. [33] As shown in Figure 3.6, meta-analyses, systematic reviews, and RCTs provide stronger best-practice evidence and scientific base for clinical practice than descriptive studies as well as case reports and case series. Nonetheless, it is important to note that the research question/ hypothesis determines the study design, and not all questions can be answered using an interventional design. In addition, there are other factors that need to be considered when choosing a study design, such as funding, time constraints, and ethical considerations, and these factors are discussed in detail in chapter 6.

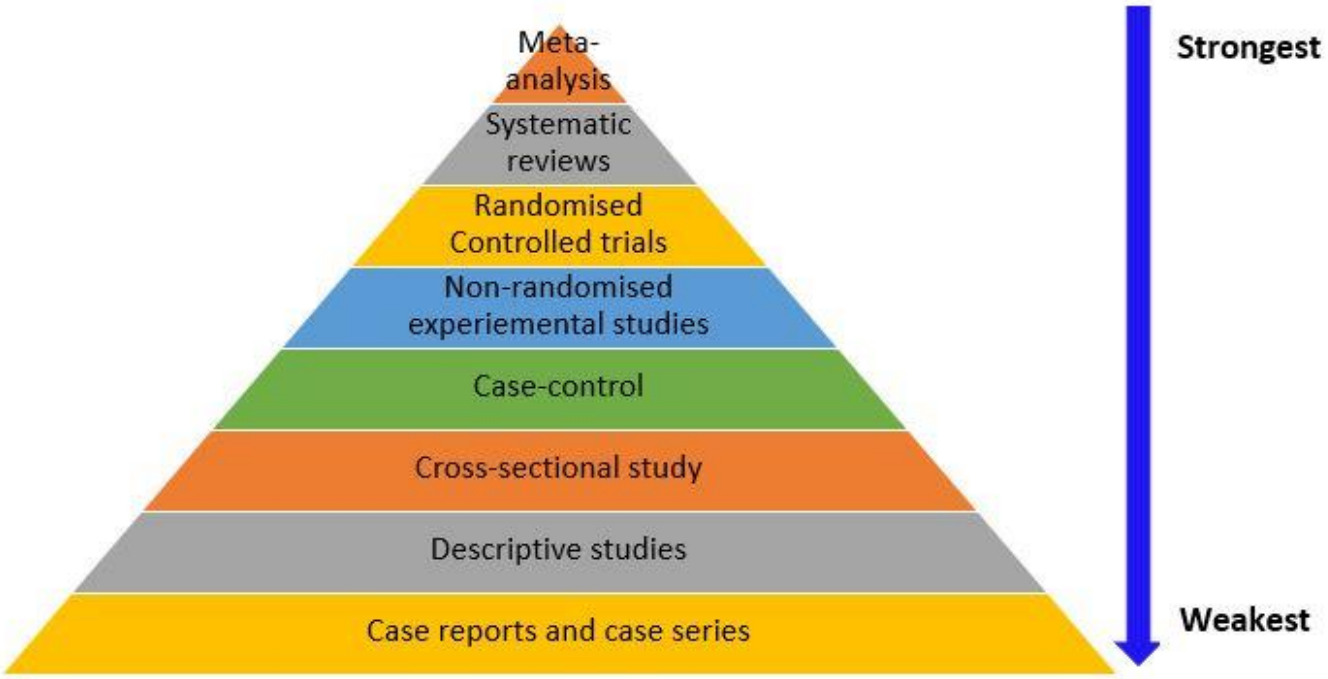

Figure 3.6 Hierarchy of Evidence by Bunmi Malau-Aduli and Faith Alele, adapted from Buettner 2015, used under a CC BY NC 4.0 licence

3.3 METHODS OF QUANTITATIVE DATA COLLECTION

Data collection is the process of gathering information for research purposes. Data collection methods in quantitative research refer to the techniques or tools used to collect data from participants or units in a study. Data are the most important asset for any researcher because they provide the researcher with the knowledge necessary to confirm or refute their research hypothesis.[2] The choice of data collection method will depend on the research question, the study design, the type of data to be collected, and the available resources. There are two main types of data which are primary data and secondary data.[34] These data types and their examples are discussed below.

Data Sources

Secondary data

Secondary data is data that is already in existence and was collected for other purposes and not for the sole purpose of a researcher's project.[34] These pre-existing data include data from surveys, administrative records, medical records, or other sources (databases, internet). Examples of these data sources include census data, vital registration (birth and death), registries of notifiable diseases, hospital data and health-related data such as the national health survey data and national drug strategy household survey.[2] While secondary data are population-based, quicker to access, and cheaper to collect than primary data, there are some drawbacks to this data source. Potential disadvantages include accuracy of the data, completeness, and appropriateness of the data, given that the data was collected for an alternative purpose.[2]

Primary data

Primary data is collected directly from the study participants and used expressly for research purposes.[34] The data collected is specifically targeted at the research question, hypothesis and aims. Examples of primary data include observations and surveys (questionnaires).[34]

- *Observations:* In quantitative research, observations entail systematically watching and recording the events or behaviours of interest. Observations can be used to collect information on variables that may be difficult to quantify through self-reported methods. Observations, for example, can be used to obtain clinical measurements involving the use of standardised instruments or tools to measure physical, cognitive, or other variables of interest. Other examples include experimental or laboratory studies that necessitate the collection of physiological data such as blood pressure, heart rate, urine, e.t.c.[2]

- *Surveys:* While observations are useful data collection methods, surveys are more commonly used data collection methods in healthcare research.[2, 34] Surveys or questionnaires are designed to seek specific information such as knowledge, beliefs, attitudes and behaviour from respondents.[2, 34] Surveys can be employed as a single research tool (as in a cross-sectional survey) or as part of clinical trials or epidemiological studies.[2, 34] They can be administered face-to-face, via telephone, paper-based, computer-based or a combination of the different methods.[2] Figure 3.7 outlines some advantages and disadvantages of questionnaires/surveys.

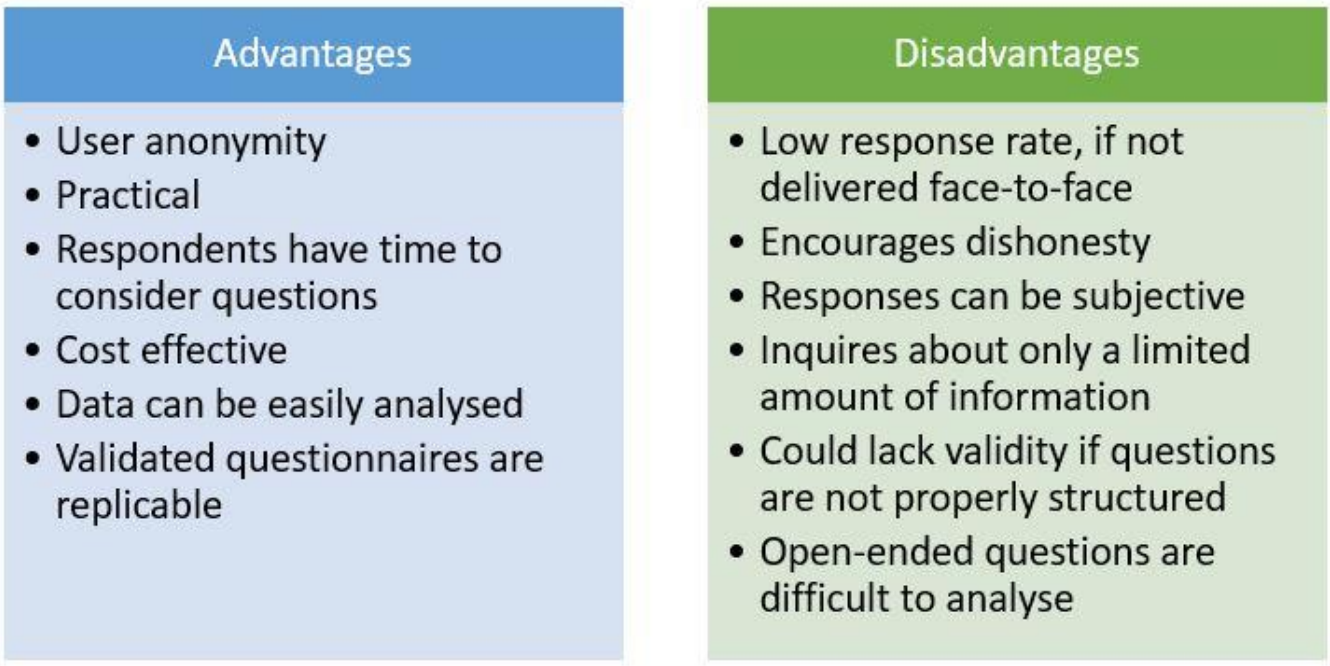

Figure 3.7 Advantages and disadvantages of questionnaires by Bunmi Malau-Aduli and Faith Alele. Adapted from Ackroyd and Hughes 1981 [50], used under a CC BY NC 4.0 licence

Designing a survey/questionnaire

A questionnaire is a research tool that consists of questions that are designed to collect information and generate statistical data from a specified group of people (target population). There are two main considerations in relation to design principles, and these are (1) content and (2) layout and sequence.[36] In terms of content, it is important to review the literature for related validated survey tools, as this saves time and allows for the comparison of results. Additionally, researchers need to minimise complexity by using simple direct language, including only relevant and accurate questions, with no jargon.[36] Concerning layout and sequence, there should be a logical flow of questions from general and easier to more sensitive ones, and the questionnaire should be as short as possible and NOT overcrowded.[36] The following steps can be used to develop a survey/ questionnaire.

Question Formats

Open and closed-ended questions are the two main types of question formats.[2] Open-ended questions allow respondents to express their thoughts without being constrained by the available options.[2, 38] Open-ended questions are chosen if the options are many and the range of answers is unknown.[38]

On the other hand, closed-ended questions provide respondents with alternatives and require that they select one or more options from a list.[38] The question type is favoured if the choices are few and the range of responses is well-known.[38] However, other question formats may be used when assessing things on a continuum, like attitudes and behaviour. These variables can be considered using rating scales like visual analogue scales, adjectival scales and Likert scales. [2] Figure 3.8 presents a visual representation of some question types, including open-ended, closed-ended, likert rating scales, symbols, and visual Analogue Scales.

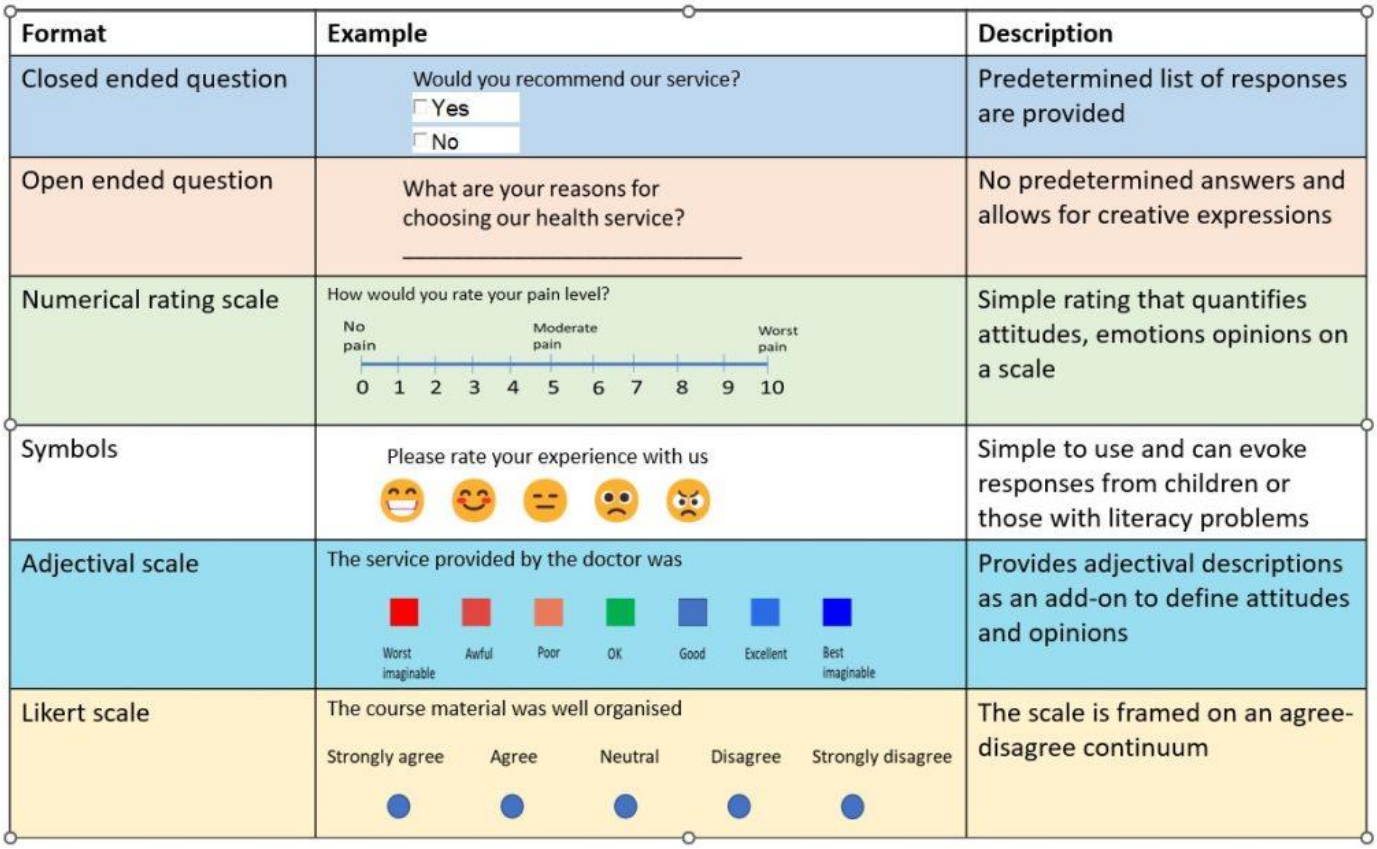

Figure 3.8 Question formats by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

It is important to carefully craft survey questions to ensure that they are clear, unbiased and accurately capture the information researchers seek to gather. Clearly written questions with consistency in wording increase the likelihood of obtaining accurate and reliable data. Poorly crafted questions, on the other hand, may sway respondents to answer in a particular way which can

undermine the validity of the survey. The following are some general guidelines for question wording.[39]

Be concise and clear: Ask succinct and precise questions, and do not use ambiguous and vague words. For example, do not ask a patient, "***how was your clinic experience***? What do you mean by clinic experience? Are you referring to their interactions with the nurses, doctors or physiotherapists?

Instead, consider using a better-phrased question such as "*please rate your experience with the doctor during your visit today*".

Avoid double-barrelled questions. Some questions may have dual questions, for example: *Do you think you should eat less and exercise more?*

Instead, ask:

- Do you think you should eat less?
- Do you think you should exercise more?

Steer clear of questions that involve negatives: Negatively worded questions can be confusing. For example, *I find it difficult to fall asleep unless I take sleeping pills*.

A better phrase is, "sleeping pills make it easy for me to fall asleep."

Ask for specific answers. It is better to ask for more precise information. For example, "what is your age in years?_____ Is preferable to -Which age category do you belong to?

☐ <18 years

☐18 – 25 years

☐25 – 35 years

☐> 35 years

The options above will give more room for errors because the options are not mutually exclusive (there are overlaps) and not exhaustive (there are older age groups above 35 years).

Avoid leading questions. Leading questions reduces objectivity and make respondents answer in a particular way. Questions related to values and beliefs should be neutrally phrased. For example, the

question below is worded in a leading way – *Conducting research is challenging. Does research training help to prepare you for your research project?*

An appropriate alternative: *Research training prepares me for my research project.*

Strongly agree Agree Disagree Strongly disagree

3.4 SAMPLING TECHNIQUES IN QUANTITATIVE RESEARCH

Target Population

The target population includes the people the researcher is interested in conducting the research and generalizing the findings on.[40] For example, if certain researchers are interested in vaccine-preventable diseases in children five years and younger in Australia. The target population will be all children aged 0–5 years residing in Australia. The actual population is a subset of the target population from which the sample is drawn, e.g. children aged 0–5 years living in the capital cities in Australia. The sample is the people chosen for the study from the actual population (Figure 3.9). The sampling process involves choosing people, and it is distinct from the sample.[40] In quantitative research, the sample must accurately reflect the target population, be free from bias in terms of selection, and be large enough to validate or reject the study hypothesis with statistical confidence and minimise random error.[2]

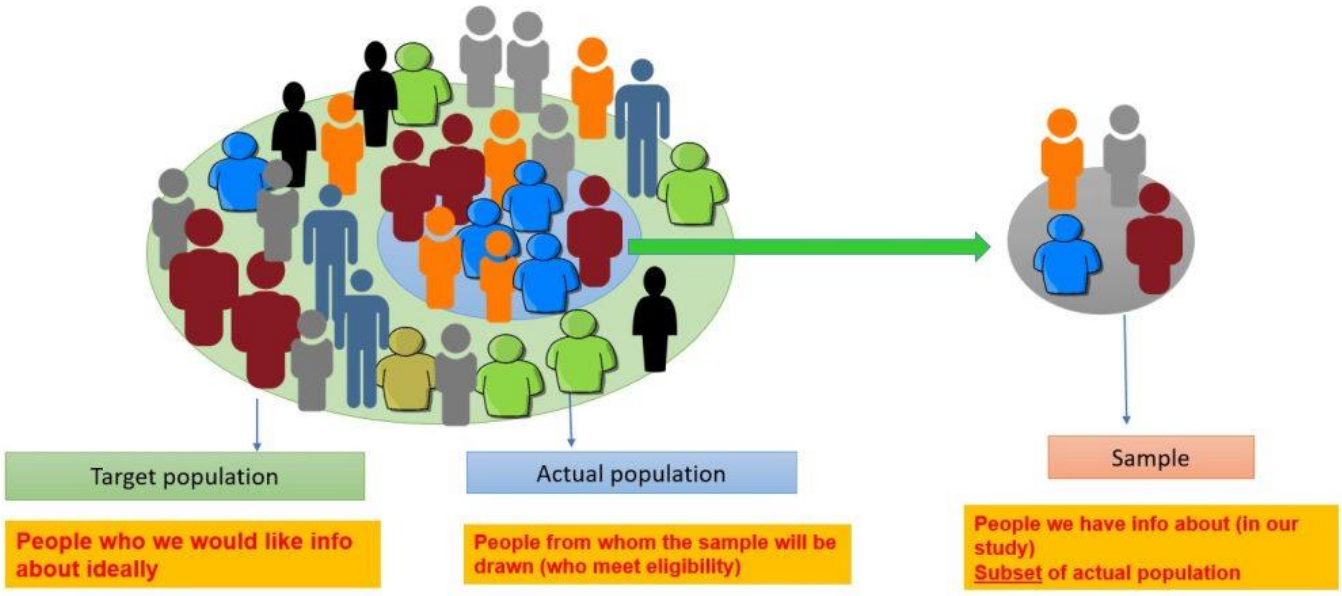

Figure 3.9 The Hierarchy of Populations by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Sampling techniques

Sampling in quantitative research is a critical component that involves selecting a representative subset of individuals or cases from a larger population and often employs sampling techniques based on probability theory.[41] The goal of sampling is to obtain a sample that is large enough and representative of the target population. Examples of probability sampling techniques include simple random sampling, stratified random sampling, systematic random sampling and cluster sampling (*shown below*).[2] The key feature of probability techniques is that they involve randomization. There are two main characteristics of probability sampling. All individuals of a population are accessible to the researcher (theoretically), and there is an equal chance that each person in the population will be chosen to be part of the study sample.[41] While quantitative research often uses sampling techniques based on probability theory, some non-probability techniques may occasionally be utilised in healthcare research.[42] Non-probability sampling methods are commonly used in qualitative research. These include purposive, convenience, theoretical and snowballing and have been discussed in detail in chapter 4.

Sample size calculation

In order to enable comparisons with some level of established statistical confidence, quantitative research needs an acceptable sample size.[2] The sample size is the most crucial factor for reliability (reproducibility) in quantitative research. It is important for a study to be powered – the likelihood of identifying a difference if it exists in reality.[2] Small sample-sized studies are more likely to be underpowered, and results from small samples are more likely to be prone to random error.[2] The formula for sample size calculation varies with the study design and the research hypothesis.[2] There are numerous formulae for sample size calculations, but such details are beyond the scope of this book. For further readings, please consult the biostatistics textbook by Hirsch RP, 2021.[43] However, we will introduce a simple formula for calculating sample size for cross-sectional studies with prevalence as the outcome.[2]

$$n = \frac{z^2 * p(1-p)}{d^2}$$

z is the statistical confidence; therefore, z = 1.96 translates to 95% confidence; z = 1.68 translates to 90%
confidence

p = Expected prevalence (of health condition of interest)

d = Describes intended precision; d = 0.1 means that the estimate falls +/-10 percentage points of true prevalence with the considered confidence. (e.g. for a prevalence of 40% (0.4), if d=.1, then the estimate will fall between 30% and 50% (0.3 to 0.5).

Example: A district medical officer seeks to estimate the proportion of children in the district receiving appropriate childhood vaccinations. Assuming a simple random sample of a community is to be selected, how many children must be studied if the resulting estimate is to fall within 10% of the true proportion with 95% confidence? It is expected that approximately 50% of the children receive vaccinations

$$\text{Sample size: } n = \frac{z^2 * p(1-p)}{d^2}$$

z = 1.96 (95% confidence)

d = 10% = 10/ 100 = 0.1 (estimate to fall within 10%)

p = 50% = 50/ 100 = 0.5

Now we can enter the values into the formula

$$= \frac{1.96^2 * 0.5(1-0.5)}{0.1^2} = \frac{3.8416 * 0.5(0.5)}{0.01} = \frac{3.8416 * 0.25}{0.01} = \frac{0.9604}{0.01} = 96.04 \sim 97 \text{ people}$$

Given that people cannot be reported in decimal points, it is important to round up to the nearest whole number.

3.5 AVOIDING ERRORS IN QUANTITATIVE RESEARCH

Quantitative researchers must assess the internal validity of the study's findings (whether the observed findings are true). A study is only deemed valid when the following three alternative explanations (major errors) have been ruled out – random error, bias and confounding. [37]

1. Random error: The likelihood that the observed result is due to chance, an uncontrollable force with no discernible source. [37] Random error arises from measurement error and sampling variability. Random error mainly affects precision, which is how reproducible the same measurement is under equivalent circumstances. [37] To explain this concept, let's assume that a researcher aims to estimate smoking prevalence among students in a particular high school (See Figure 3.10 below). The researcher recruits an initial sample of eight (8) students. Of these eight students, three admit smoking cigarettes – therefore, smoking prevalence is 3/8 = 37.5%. If the researcher decides to repeat the study in the same high school, recruiting another set of eight students, if this following sample has five smokers, smoking prevalence will be 5/8 = 62.5%. When based on a sample of n = 8, sample-to-sample variability is high and this is referred to as random sampling error.

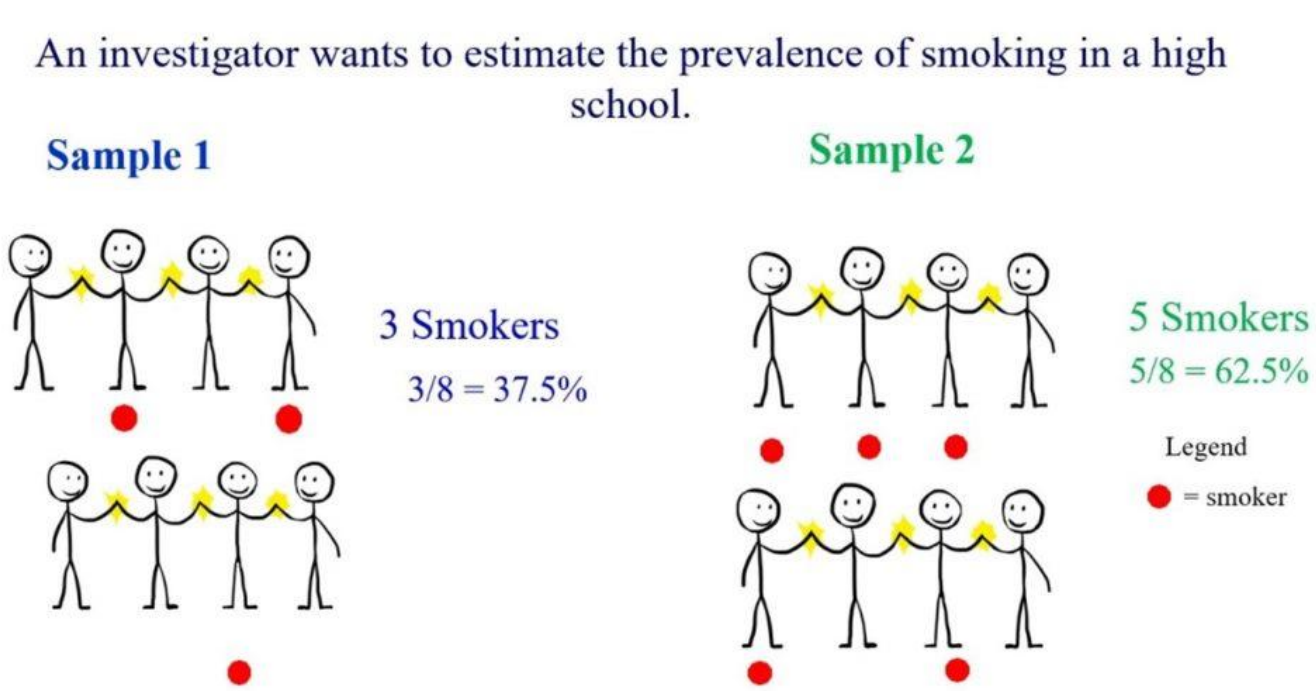

Figure 3.10 Random error- estimating smoking prevalence among eight students by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

However, as shown in Figure 3.11, the amount of random error in a sample will reduce if the sample size is increased. If the study is conducted with 100 students, and 30 students identify as smokers, this will yield a prevalence of 30%. If another sample of 100 students is recruited again, with 35 smokers, the prevalence will be 35%.

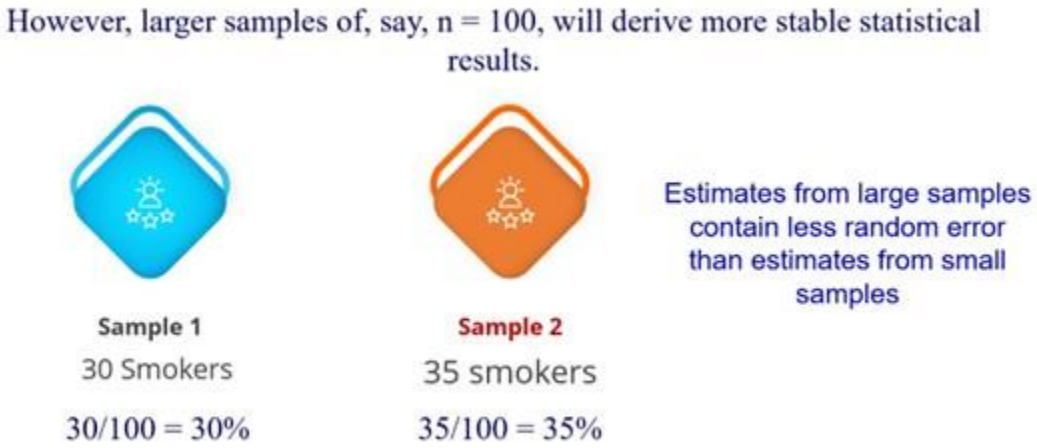

Figure 3.11 Random error- estimating smoking prevalence among 100 students by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

2. Bias: This is a systematic error in the design or conduct of a study that results in an erroneous association between exposure and outcome; it is impossible to avoid by increasing sample size. [2] Systematic error arises when the findings deviate from the real values in a systematic manner. The two forms of bias are selection bias and measurement bias. Selection bias occurs when individuals or groups in a study differ systematically from the population of interest leading to a systematic error in an association or outcome. [2] Examples of selection bias are volunteer bias, poor response rate, loss to follow-up ('survival'), unhealthy worker impact, and detection bias (medically relevant exposure leads to closer surveillance for study results, which may result in a bias). [2] Bias in the way information is obtained is defined as measurement bias, and it is also referred to as observation or information bias. [37] Measurement bias occurs while measuring or categorising the exposure, the outcome, or both. Examples of measurement bias include record abstracting error, recollection bias, interviewer/observer bias, digital bias (preferring specific numbers), placebo effect, and Hawthorne effect (individuals modifying an aspect of their behaviour in response to their awareness of being observed). [2, 37]
3. Confounding: A confounder is a variable that mixes or muddles the effect or distorts the association between the dependent and independent variables, causing a spurious association. [2, 37] These three conditions must be fulfilled for a variable to be classified as a confounder. A confounder must be associated with the outcome, must be associated with the exposure and must not lie on the causal pathway between an exposure and outcome. [2, 37] Some common confounders include age, gender, socioeconomic status and smoking. [2, 37] For example, researchers are interested in the association between alcohol and mortality. The researchers found out that those who consumed more alcohol were more likely to die. However, the researchers have not considered variables like age, gender, smoking and diet. These variables are also known to be associated with both alcohol and mortality. For example, those who consume alcohol less are more likely to eat healthier or are less likely to smoke.

3.6 QUANTITATIVE DATA ANALYSIS

Remember that quantitative research explains phenomena by collecting numerical data that are analysed using statistics.[1] Statistics is a scientific method of collecting, processing, analysing, presenting and interpreting data in numerical form.[44] This section discusses how quantitative data is analysed and the choice of test statistics based on the variables (data). First, it is important to understand the different types of variables before delving into the statistical tests.

Types of variables

A variable is an item (data) that can be quantified or measured. There are two main types of variables – numerical variables and categorical variables.[45] Numerical variables describe a measurable quantity and are subdivided into two groups – discrete and continuous data. Discrete variables are finite and are based on a set of whole values or numbers such as 0, 1, 2, 3,… (integer). These data cannot be broken into fractions or decimals.[45] Examples of discrete variables include the number of students in a class and the total number of states in Australia. Continuous variables can assume any value between a certain set of real numbers e.g. height and serum glucose levels. In other words, these are variables that are in between points (101.01 to 101.99 is between 101 and 102) and can be broken down into different parts, fractions and decimals.[45]

On the other hand, categorical variables are qualitative and describe characteristics or properties of the data. This type of data may be represented by a name, symbol or number code.[46] There are two types- nominal and ordinal variables. Nominal data are variables having two or more categories without any intrinsic order to the categories.[46] For example, the colour of eyes (blue, brown, and black) and gender (male, female) have no specific order and are nominal categorical variables. Ordinal variables are similar to nominal variables with regard to describing characteristics or properties, but these variables have a clear, logical order or rank in the data.[46] The level of education (primary, secondary and tertiary) is an example of ordinal data.

Now that you understand the different types of variables, identify the variables in the scenario in the Padlet below.

Statistics

Statistics can be broadly classified into descriptive and inferential statistics. Descriptive statistics explain how different variables in a sample or population relate to one another.[60] Inferential statistics draw conclusions or inferences about a whole population from a random sample of data.[45]

Descriptive statistics

This is a summary description of measurements (variables) from a given data set, e.g., a group of study participants. It provides a meaningful interpretation of the data. It has two main measures – central tendency and dispersion measures.[45]

The measures of central tendency describe the centre of data and provide a summary of data in the form of mean, median and mode. Mean is the average distribution, the median is the middle value (skewed distribution), and mode is the most frequently occurring variable.[4]

Mean $\bar{x} = \frac{\sum x}{n}$ Where x = each observation and n = the number of observations.

The measures of dispersion describe the spread of data, including range, variance, and standard deviation.[45] The range defines the spread of the data, and it is described by the maximum and minimum values of the data. Variance is the average degree to which each point differs from the mean. The standard deviation is the square root of variance.[45]

Variance $S^2 = \frac{\sum(x_i - \bar{x})^2}{n-1}$ where x = sample mean, x_i = i^{th} element from the sample and n = the number of elements in the sample.

Standard deviation $\sigma = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}}$

- ***Descriptive statistics for continuous variables***

An example is a study conducted among 145 students where their height and weight were obtained. The summary statistics (a measure of central tendency and dispersion) have been presented below in table 3.2.

Table 3.2 Descriptive statistics for continuous variables

Variable	Measures of central tendency			Measures of dispersion				
	Mean	Median	Mode	Variance	Standard deviation	Range	Minimum	Maximum

Height (cm)	169.8	169.0	164.0	60.4	7.8	89.0	151.0	190.0
Weight (kg)	68.9	66.0	60.0	163.1	12.8	74.0	46.0	120.0

- **Descriptive statistics for categorical variables**

Categorical variables are presented using frequencies and percentages or proportions. For example, a hypothetical scenario is a study on smoking history by gender in a population of 4609 people. Below is the summary statistic of the study (Table 3.3).

Table 3.3 Descriptive statistics for categorical variables

Variable	**Males**		**Females**	
	N	**Per cent**	**N**	**Per cent**
Smoking				

Smoker	636	28.7%	196	8.2%
Non-smoker	1577	71.3%	2200	91.8%
Total	**2213**		**2396**	

Normality of data

Before proceeding to inferential statistics, it is important to assess the normality of the data. A normality test evaluates whether or not a sample was selected from a normally distributed population.[47] It is typically used to determine if the data used in the study has a normal distribution. Many statistical techniques, notably parametric tests, such as correlation, regression, t-tests, and ANOVA, are predicated on normal data distribution.[47] There are several methods for assessing whether data are normally distributed. They include graphical or visual tests such as histograms and Q-Q probability plots and analytical tests such as the Shapiro-Wilk test and the Kolmogrorov-Smirnov test.[47] The most useful visual method is visualizing the normality distribution via a histogram, as shown in Figure 3.12. On the other hand, the analytical tests (Shapiro-Wilk test and the Kolmogrorov-Smirnov) determine if the data distribution deviates considerably from the normal distribution by using criteria such as the p-value.[47] If the p-value is < 0.05, the data is not normally distributed.[47] These analytical tests can be conducted using statistical software like SPSS and R.

However, when the sample size is > 30, the violation of the normality test is not an issue and the sample is considered to be normally distributed. According to the central limit theorem, in large samples of > 30 or 40, the sampling distribution is normal regardless of the shape of the data.[47, 48] Normally distributed data are also known as parametric data, while non-normally distributed data are known as non-parametric data.

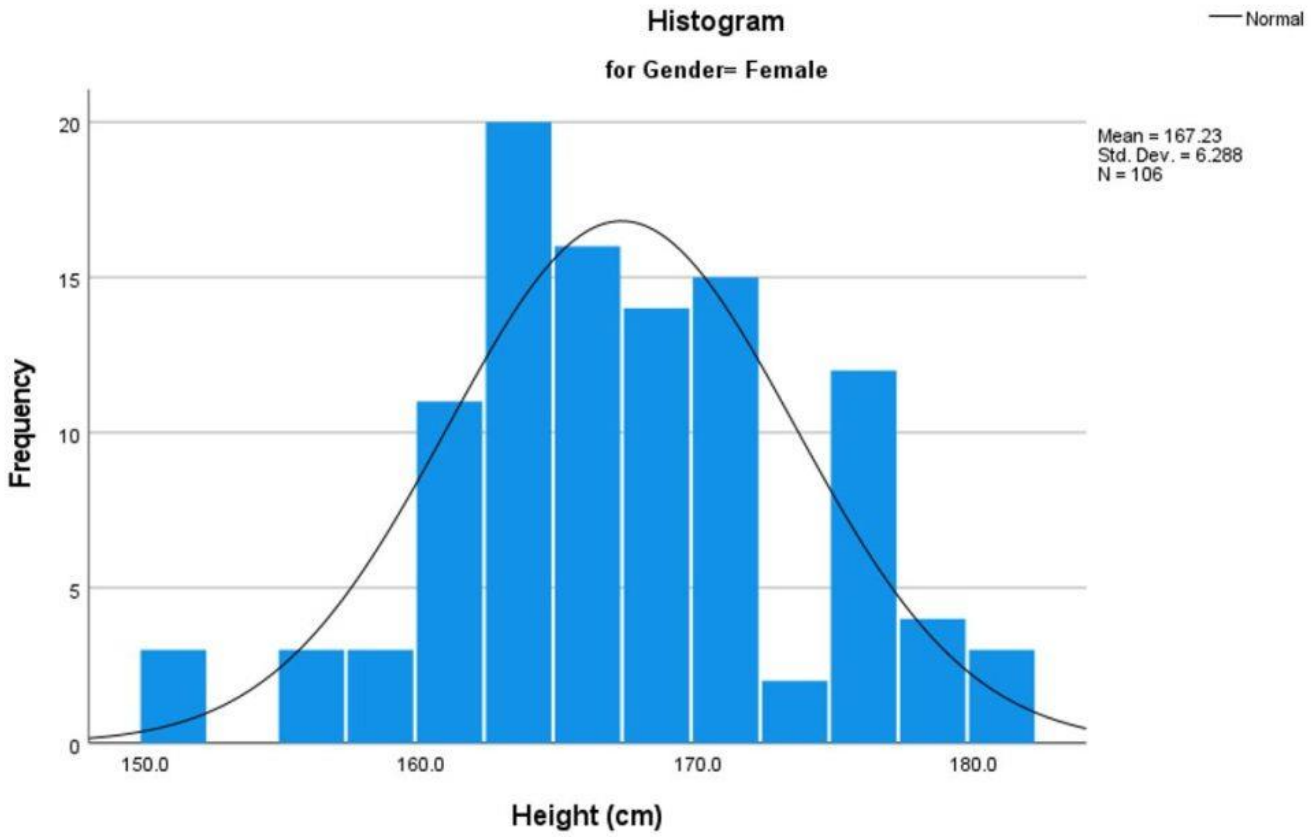

Figure 3.12 An example of a histogram showing normal distribution of height among female respondents in a study by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC licence

Table 3.4 Tests of normality for height by gender

Tests of Normality

Height (cm)	Gender	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	p-value (Sig.)	Statistic	df	p-value (Sig.)
	Male	0.059	39	0.200	0.983	39	0.814
	Female	0.082	106	0.076	0.981	106	0.146

Inferential statistics

This statistical analysis involves the analysis of data from a sample to make inferences about the target population.[45] The goal is to test hypotheses. Statistical techniques include parametric and non-parametric tests depending on the normality of the data.[45] Conducting a statistical analysis requires choosing the right test to answer the research question.

Steps in a statistical test

The choice of the statistical test is based on the research question to be answered and the data. There are steps to take before choosing a test and conducting an analysis.[49]

- State the research question/aim
- State the null and alternative hypothesis

The null hypothesis states that there is no statistical difference exists between two variables or in a set of given observations. The alternative hypothesis contradicts the null and states that there is a statistical difference between the variables.

- Decide on a suitable statistical test based on the type of variables.

Is the data normally distributed? Are the variables continuous, discrete or categorical data? The identification of the data type will aid the appropriate selection of the right test.

- Specify the level of significance (α -for example, 0.05). The level of significance is the probability of rejecting the null hypothesis when the null is true. The hypothesis is tested by calculating the probability (P value) of observing a difference between the variables, and the value of p ranges from zero to one. The more common cut-off for statistical significance is 0.05. [50]
- Conduct the statistical test analysis- calculate the p-value
- Make a statistical decision based on the findings
  - p<0.05 leads to rejection of the null hypothesis
  - p>0.05 leads to retention of the null hypothesis
- Interpret the results

In the next section, we have provided an overview of the statistical tests. The step-by-step conduct of the test using statistical software is beyond the scope of this book. We have provided the theoretical basis for the test. Other books, like Pallant's SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS, is a good resource if you wish to learn how to run the different tests.[48]

TYPES OF STATISTICAL TESTS

A distinction is always made based on the data type (categorical or numerical) and if the data is paired or unpaired. Paired data refers to data arising from the same individual at different time points, such as before and after or pre and post-test designs. In contrast, unpaired data are data from separate individuals. Inferential statistics can be grouped into the following categories:

- Comparing two categorical variables
- Comparing one numerical and one categorical variable
  - o Two sample groups (one numerical variable and one categorical variable in two groups)
  - o Three sample groups (one numerical variable and one categorical variable in three groups)
- Comparing two numerical variables

Comparing two categorical variables

Deciding on the choice of test with two categorical variables involves checking if the data is nominal or ordinal and paired versus unpaired. The figure below (Figure 3.13) shows a decision tree for categorical variables.

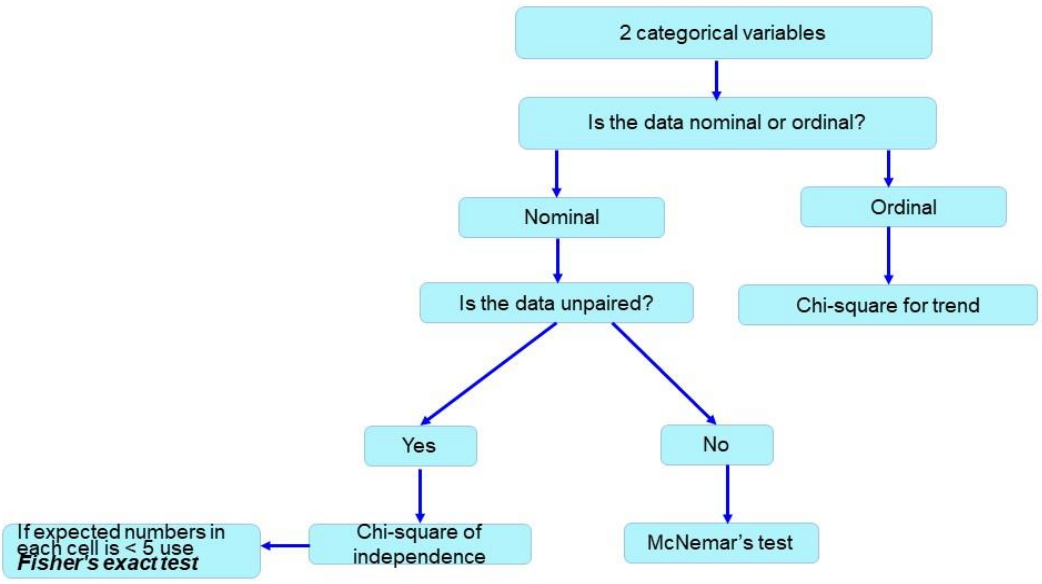

Figure 3.13 Comparing categorical variables by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- *Chi-square test of independence*

The chi-square test of independence compares the distribution of two or more independent data sets.[44] The chi-square value increases when the distributions are found to be increasingly similar, indicating a stronger relationship between them. A value of $\chi 2 = 0$ means that there is no relationship between the variables.[44] There are preconditions for the Chi-square test, which include a sample size > 60, and the expected number in each field should not be less than 5. ***Fisher's exact test*** is used if the conditions are not met.

- *McNemar's test*

Unlike the Chi-square test, Mcnemar's test is designed to assess if there is a difference between two related or paired groups (categorical variables).[51]

- *Chi-square for trend*

The chi-square test for trend tests the relationship between one variable that is binary and the other is ordered categorical.[52] The test assesses whether the association between the variables follows a trend. For example, the association between the frequency of mouth rinse (once a week, twice a week and seven days a week) and the presence of dental gingivitis (yes vs no) can be assessed to observe a dose-response effect between mouth rinse usage and dental gingivitis.[52]

Tests involving one numerical and one categorical variable

The variables involved in this group of tests are one numerical variable and one categorical variable. These tests have two broad groups – two sample groups and three or more sample groups, as shown in Figures 3.14 and 3.15.

Two sample groups

The parametric two-sample group of tests (independent samples t-test and paired t-test) compare the means of the two samples. On the other hand, the non-parametric tests (Mann-Whitney U test and Wilcoxon Signed Rank test) compare medians of the samples.

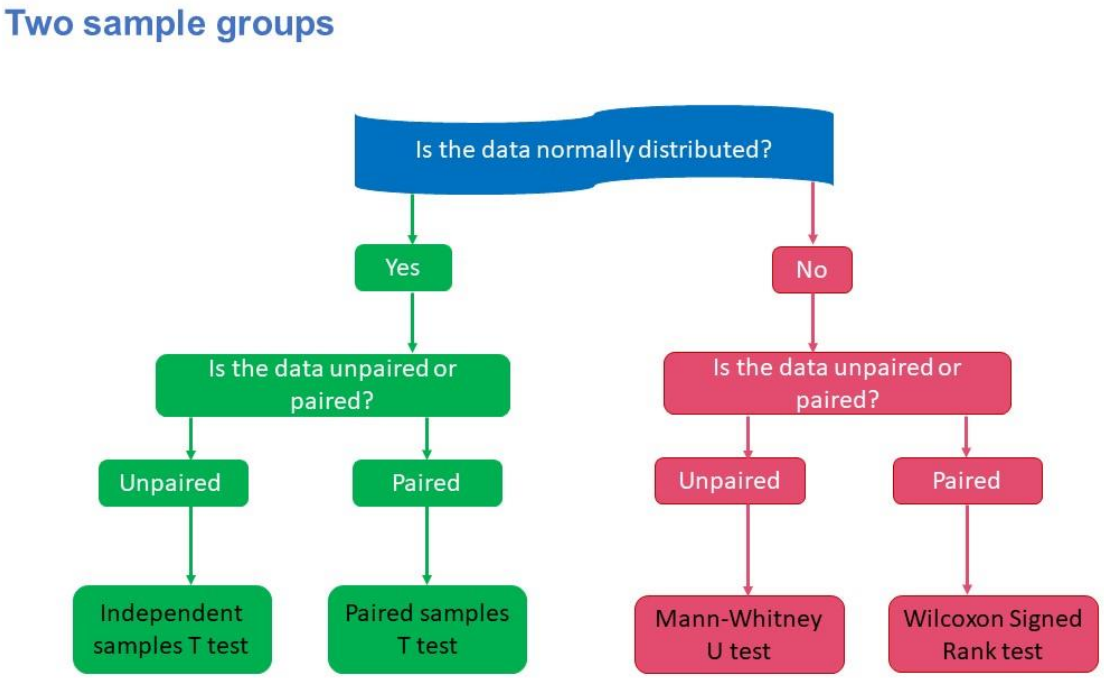

Figure 3.14 Two sample groups by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- *Parametric: Independent samples T-test and Paired Samples t-test*

The independent or unpaired t-test is used when the participants in both groups are independent of one another (those in the first group are distinct from those in the second group) and when the parameters are typically distributed and continuous.[44] On the other hand, the paired t-test is used to test two paired sets of normally distributed continuous data. A paired test involves measuring the same item twice on each subject.[44] For instance, you would wish to compare the differences in each subject's heart rates before and after an exercise. The tests compare the mean values between the groups.

- *Non-parametric: Mann-Whitney U test and Wilcoxon Signed Rank test*

The nonparametric equivalents of the paired and independent sample t-tests are the Wilcoxon signed-rank test and the Mann-Whitney U test.[44] These tests examine if the two data sets' medians are equal and whether the sample sets are representative of the same population.[44] They have less power than their parametric counterparts, as is the case with all nonparametric tests but can be applied to data that is not normally distributed or small samples.[44]

Three samples group

The t-tests and their non-parametric counterparts cannot be used for comparing three or more groups. Thus, three or more sample groups of the test are used. The parametric three samples group of tests are one-way ANOVA (Analysis of variance) and repeated measures ANOVA. In contrast, the non-parametric tests are the Kruskal-Wallis test and the Friedman test.

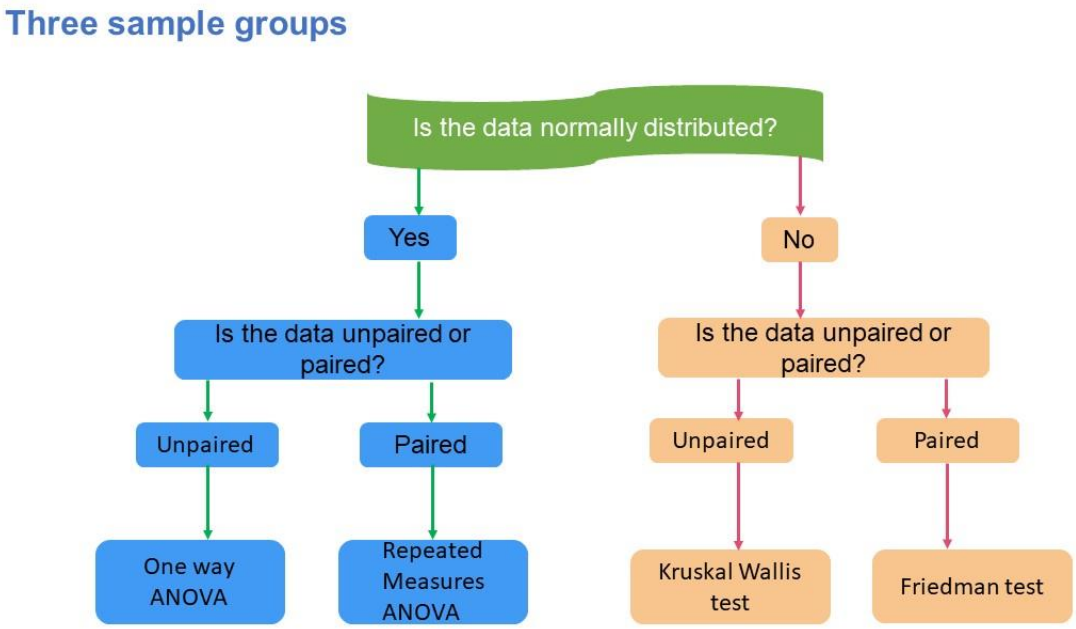

Figure 3.15 Three sample groups by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- Parametric: One-way ANOVA and Repeated measures ANOVA

ANOVA is used to determine whether there are appreciable differences between the means of three or more groups.[45] Within-group and between-group variability are the two variances examined in a one-way ANOVA test. The repeated measures ANOVA examines whether the means of three or more groups are identical.[45] When all the variables in a sample are tested under various circumstances or at various times, a repeated measure ANOVA is utilized.[45] The dependent variable is measured repeatedly as the variables are determined from samples at various times. The data don't conform to the ANOVA premise of independence; thus, using a typical ANOVA in this situation is inappropriate.[45]

- Non-parametric: Kuskal Wallis test and Friedman test

The non-parametric test to analyse variance is the Kruskal-Wallis test. It examines if the median values of three or more independent samples differ in any way.[45] The test statistic is produced after the rank sums of the data values, which are ranked in ascending order. On the other hand, the Friedman test is the non-parametric test for comparing the differences between related samples. When the same parameter is assessed repeatedly or under different conditions on the same participants, the Friedman test can be used as an alternative to repeated measures ANOVA.[45]

Comparing two numerical variables

Pearson's correlation and regression tests are used to compare two numerical variables.

- Pearson's Correlation and Regression

Pearson's correlation (r) indicates a relationship between two numerical variables assuming that the relationship is linear.[53] This implies that for every unit rise or reduction in one variable, the other increases or decreases by a constant amount. The values of the correlation coefficient vary from -1 to + 1. Negative correlation coefficient values suggest a rise in one variable will lead to a fall in the other variable and vice versa.[53] Positive correlation coefficient values indicate a propensity for one variable to rise or decrease in tandem with another. Pearson's correlation also quantifies the strength of the relationship between the two variables. Correlation coefficient values close to zero suggest a weak linear relationship between two variables, whereas those close to -1 or +1 indicate a robust linear relationship between two variables.[53] It is important to note that correlation does not imply causation. The Spearman rank correlation coefficient test (rs) is the nonparametric equivalent of the Pearson coefficient. It is useful when the conditions for calculating a meaningful r value cannot be satisfied and numerical data is being analysed.[44]

Regression measures the connection between two correlated variables. The variables are usually labelled as dependent or independent. An independent variable is a factor that influences a dependent variable (which can also be called an outcome).[54] Regression analyses describe, estimate, predict and control the effect of one or more independent variables while investigating the relationship between the independent and dependent variables. [54] There are three common types of regression analyses – linear, logistic and multiple regression.[54]

- Linear regression examines the relationship between one continuous dependent and one continuous independent variable. For example, the effect of age on shoe size can be analysed using linear regression.[54]
- Logistic regression estimates an event's likelihood with binary outcomes (present or absent). It involves one categorical dependent variable and two or more continuous or categorical predictor (independent) variables.[54]
- Multiple regression is an extension of simple linear regression and investigates one continuous dependent and two or more continuous independent variables.[54]

3.7 QUANTITATIVE RIGOUR

The extent to which the researchers strive to improve the quality of their study is referred to as rigour. Rigor is accomplished in quantitative research by measuring validity and reliability. [55] These concepts affect the quality of findings and their applicability to broader populations.

Validity

Validity refers to the accuracy of a measure. It is the extent to which a study or test accurately measures what it sets out to measure. There are three main types of validity – content, construct and criterion validity.

- *Content validity:* Content validity examines whether the instrument adequately covers all aspects of the content that it should with respect to the variable under investigation. [56] This type of validity can be assessed through expert judgment and by examining the coverage of items or questions in measure. [56] Face validity is a subset of content validity in which experts are consulted to determine if a measurement tool accurately captures what it is supposed to measure. [56] There are multiple methods for testing content validity – content validity index (CVI) and content validity ratio (CVR). CVI is calculated as the number of experts giving a rating of "very relevant" for each item divided by the total number of experts. Values range from 0 to 1, with items having a CVI score > 0.79 relevant; between 0.70 and 0.79, the item needs revisions, and if the value is below 0.70, the item is eliminated. [57] CVR varies between 1 and −1; a higher score indicates greater agreement among panel members. CVR is calculated as (Ne – N/2)/(N/2), where Ne is the number of panellists indicating an item as "essential" and N is the total number of panelists. [57] A study by Mousazadeh et al. 2017 investigated the content, face validity and reliability of sociocultural attitude towards appearance questionnaire-3 (SATAQ-3) among female adolescents. [58] To ensure face validity, the questionnaire was given to 25 female adolescents, a psychologist and three nurses, who were required to evaluate the items with respect to problems, ambiguity, relativity, proper terms and grammar, and understandability. For content validity, 15 experts in psychology and nursing were asked to assess the qualitative content validity. To determine the quantitative content validity, the content validity index and content validity ratio were calculated. [58]
- *Construct validity:* A construct is an idea or theoretical concept based on empirical observations that are not directly measurable. An example of a construct could be physical functioning or social anxiety. Thus construct validity determines whether an instrument measures the underlying construct of interest and discriminates it from other related constructs. 55 It is important and expresses the confidence that a particular construct is valid. [55] This type of validity can be assessed using factor analysis or other statistical techniques. For example, Pinar, Rukiye 2005, evaluated the reliability and construct validity of the SF-36 in Turkish cancer patients. [59] The SF-36 is widely used to measure the

quality of life or health status in sick and healthy populations. Principal components factor analysis with varimax rotation confirmed the presence of the seven domains in the SF-36: in the SF-36: physical functioning, role limitations due to physical and emotional problems, mental health, general health perception, bodily pain, social functioning, and vitality. It was concluded that the Turkish version of the SF-36 was a suitable instrument that could be employed in cancer research in Turkey. [59]

- *Criterion validity:* Criterion validity is the relationship between an instrument score and some external criterion. This criterion is considered the "gold standard" and has to be a widely accepted measure that shares the same characteristics as the assessment tool. [55] Determining the validity of a new diagnostic test requires two principal factors – sensitivity and specificity. [60] Sensitivity refers to the probability of detecting those with the disease, while specificity refers to the probability of the test correctly identifying those without the disease. [60] For example, the reverse transcriptase polymerase chain reaction (RT PCR) is the gold standard for testing COVID-19; its results are available at the earliest several hours to days after testing. Rapid antigen tests are diagnostic tools that can be used at the point of care, and the results can be obtained within 30 minutes). [61, 62] Therefore, the validity of these rapid antigen tests was determined against the gold standard. [61, 62] Two published articles that assessed the validity of the rapid antigen test reported sensitivity of 71.43% and 78.3% and specificity of 99.68% and 99.5%, respectively. [61, 62] Thus indicating that the tests were less effective in

identifying those who have the disease but highly effective in identifying those who do not have the disease. While it is important to assess the accuracy of the instruments used, it is also imperative to determine if the measure and findings are reliable.

Reliability

Reliability refers to the consistency of a measure. It is the ability of a measure or tests to reproduce a consistent result over time and across different observers. [55] A reliable measurement tool produces consistent results, even when different observers administer the test or when the test is conducted on different occasions. [55, 5]6 Reliability can be assessed by examining test-retest reliability, inter-rater reliability, and internal consistency.

- *Test-retest reliability:* Test-retest reliability refers to the degree of consistency between the outcomes of the same test or measure taken by the same participants at varying times. It estimates the consistency of measurement repetition. The intraclass correlation coefficient (ICC) is often used to determine test-retest reliability. [56] For example, a study may be conducted to evaluate the reliability of a new tool for measuring pain and might administer the tool to a group of patients at two different time points and compare the results. If the results are consistent across the two-time points, this would indicate that the tool has good test-retest reliability. However, it is important to note that the reliability reduces when the time between administration of the test is extended or too long. An adequate time span between tests should range from 10 to 14 days. [56] The article by Pinar, Rukiye 2005, demonstrated this by assessing a test–retest stability using intraclass correlation coefficient-ICC. The retest procedure was conducted two weeks after the first test as two weeks was considered to be the optimum re-test interval. [59] This would be sufficiently long for participants to forget their initial responses but not too long that most health domains would change. [59]
- *Inter-observer (between observers) reliability: is also known as i*nter-rater reliability, and it is the level of agreement between two or more observers on the results of an instrument or test. It is the most popular method of determining if two things are equivalent. [55, 56] For example, a study may be conducted to evaluate the reliability of a new tool for measuring depression. This will involve two different raters or observers independently scoring the same patient on the tool and comparing the results. If the results are consistent across the two raters, this would indicate that the tool has excellent inter-rater reliability. The Kappa coefficient is a measure used to assess the agreement between the raters. [56] It can have a maximum value of 1.00; the higher the value, the greater the concordance between the raters. [56]
- *Internal consistency:* Internal consistency refers to the extent to which different items or questions in a test or questionnaire are consistent with one another. It is also known as homogeneity, which indicates whether each component of an instrument measures the same characteristics. [55] This type of reliability can be assessed by calculating Cronbach's alpha (α) coefficient, which measures the correlation between different items or questions. Cronbach α is expressed as a number between 0 and 1, and a reliability score of 0.7 or above is considered acceptable. [55] For example, Pinar, Rukiye 2005 reported that reliability evaluations of the SF-36 were based on the internal consistency test (Cronbach's α coefficient). The results showed that Cronbach's α coefficient for the eight subscales of the SF-36 ranged between 0.79 and 0.90, confirming the internal consistency of the subscales. [59]

Now you have an understanding of the quantitative methodology. Use the Padlet below to write a research question that can be answered quantitatively.

3.8 CONCLUSION

In this chapter, we discussed types of quantitative research designs, the various methods of quantitative data collection and data analysis. The scenario of Jaden exploring the world around him by investigating the differences between a blown light bulb and a new light bulb can be linked to quantitative research. Quantitative research involves using numerical data and statistical methods to gather and analyse information about a particular topic or phenomenon. In this scenario, Jaden's investigation of the light bulbs in different rooms is similar to the systematic and empirical approach used in quantitative research.

Jaden's mother used the blown light bulb as an opportunity to teach her son the concept of a burnt-out filament, which he then used to investigate the other light bulbs in the house. Similarly, quantitative researchers use existing knowledge or previous studies to develop a research question or hypothesis, which is then tested through systematic data collection and analysis. Quantitative research often involves the use of statistical techniques to analyze data, such as calculating means, standard deviations, and correlations. Jaden's search for a dark spot or break in the filament of the blown light bulb is similar to how researchers look for patterns, trends, or relationships in their data to draw conclusions.

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4. QUALITATIVE RESEARCH

"The best research you can do is talk to people" – Terry Pratchett

In this chapter you will learn about:

- qualitative approach to research/application of qualitative research in healthcare
- definition and characteristics of qualitative research
- qualitative research methodologies
- qualitative data collection and analytical methods
- rigour in qualitative research.

Opening Scenario

Sophie had just commenced her new job as a researcher in an ice cream company's research and development department. Her first task was to obtain customers' preferences for the new ice cream flavour developed by the team. Sophie decided to advertise the product all day on a Saturday at the most popular shopping mall in town and offered everyone who entered the mall a free ice cream. She felt that if a lot of people accepted the free ice cream offer, that would be an indication of customers' satisfaction with and acceptance of the new ice cream flavour. Towards the end of the day, over five hundred people had accepted the free ice cream offer. This made Sophie conclude that the flavour was acceptable to the people. Would you agree with this conclusion? If yes, why?

To wrap up the event, Sophie decided to interview the last batch of people who accepted the offer to understand their perceptions of the flavour. However, to her surprise, she found out that the people accepted the offer, not because of the flavour but because the ice cream was free! The interviews helped Sophie to elicit the main reason for the acceptance of the offer. From the interviews, she found that the participants didn't really like the new flavour, they preferred the flavour that was produced the previous year and they gave suggestions as to how the new flavour could be improved. This story indicates that numbers only don't tell the full story. As stated by Terry Pratchett,

"*The best research you can do is talk to people.*"

4.1 APPLICATION OF QUALITATIVE RESEARCH IN HEALTHCARE

As a scientifically oriented health professions student, you may be more acquainted with quantitative research than qualitative research. As shown in the opening scenario, quantitative research can aid the collection of a large amount of data about how many people are involved in a particular activity or

situation. However, it doesn't capture the study participants' voices in relation to their experience of the situation. In the healthcare setting, quantitative research can help examine how many people have certain attitudes about health issues, thereby allowing for the generalisation of findings to the wider population. On the other hand, qualitative research focuses on exploring and interpreting research participants' experiences of phenomena of interest to explain their behaviour and actions within specific contexts.[1,2] In addition, other uses of this type of research include the exploration of patient satisfaction and level of engagement.[3] Health professionals' work usually occurs within social, interpersonal or clinical contexts wherein statistical methods may be inadequate to aid the investigation of these concepts among stakeholders' (particularly patients, their carers and healthcare providers) perceptions of the quality of healthcare services provided.[4]

4.2 DEFINITIONS AND CHARACTERISTICS OF QUALITATIVE RESEARCH

Qualitative research aims to uncover the meaning and understanding of phenomena that cannot be broken down into measurable elements. It is based on naturalistic, interpretative and humanistic notions.[5] This research method seeks to discover, explore, identify or describe subjective human experiences using non-statistical methods and develops themes from the study participants' stories.[5] Figure 4.1 depicts major features/ characteristics of qualitative research. It utilises exploratory open-ended questions and observations to search for patterns of meaning in collected data (e.g. observation, verbal/written narrative data, photographs, etc.) and uses inductive thinking (from specific observations to more general rules) to interpret meaning.[6] Participants' voice is evident through quotations and description of the work.[6] The context/ setting of the study and the researcher's reflexivity (i.e. "reflection on and awareness of their bias", the effect of the researcher's experience on the data and interpretations) are very important and described as part of data collection.[6] Analysis of collected data is complex, often involves inductive data analysis (exploration, contrasts, specific to general) and requires multiple coding and development of themes from participant stories.[6]

Figure 4.1 Characteristics of Qualitative Research by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Reflexivity- avoiding bias/Role of the qualitative researcher

Qualitative researchers generally begin their work with the recognition that their position (or worldview) has a significant impact on the overall research process.[7] Researcher worldview shapes the way the research is conducted, i.e., how the questions are formulated, methods are chosen, data are collected and analysed, and results are reported. Therefore, it is essential for qualitative researchers to acknowledge, articulate, reflect on and clarify their own underlying biases and assumptions before embarking on any research project.[7] Reflexivity helps to ensure that the researcher's own experiences, values, and beliefs do not unintentionally bias the data collection, analysis, and interpretation.[7] It is the gold standard for establishing trustworthiness and has been established as one of the ways qualitative researchers should ensure rigour and quality in their work.[8] The following questions in Table 4.1 may help you begin the reflective process.[9]

Table 4.1: Questions to aid the reflection process

Questions	Explanations
What piques my interest in this subject?	**You need to consider what motivates your excitement, energy, and interest in investigating this topic to answer this question**
What exactly do I believe the solution is?	**Asking this question allows you to detect any biases by honestly reflecting on what you anticipate finding. The assumptions can be grouped/classified to allow the participants' opinions to be heard.**
What exactly am I getting out of this?	**In many circumstances, the "pressure to publish" reduces research to nothing more than a job necessity. What effect does this have on your interest in the subject and its results? To what extent are you willing to go to find information?**
What do my colleagues think of this project—and me?	**You will not work in a vacuum as a researcher; you will be part of a social and interpersonal world. These outside factors will impact your perceptions of yourself and your job.** **Recognising this impact and its possible implications on human behaviour will allow for more self-reflection during the study process.**

Philosophical underpinnings to qualitative research

Qualitative research uses an inductive approach and stems from interpretivism or constructivism and assumes that realities are multiple, socially constructed, and holistic.[10] According to this philosophical viewpoint, humans build reality through their interactions with the world around them.[10] As a result, qualitative research aims to comprehend how individuals make sense of their experiences and build meaning in their lives.[10] Because reality is complex/nuanced and context-bound, participants constantly construct it depending on their understanding. Thus, the interactions between the researcher and the participants are considered necessary to offer a rich description of the concept and provide an in-depth understanding of the phenomenon under investigation.[11]

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4.3 QUALITATIVE RESEARCH METHODOLOGIES

Phenomenology is a research approach that seeks to understand the essence of a particular phenomenon through a detailed exploration of individual experiences. It is especially beneficial for exploring personal experiences such as emotions, perceptions, and awareness. As a budding qualitative researcher, it is imperative that you understand the different qualitative methods to enable you to choose the appropriate methods for your research question. In this chapter, we aim to discuss the most common qualitative methodologies which include descriptive, phenomenology, narrative inquiry, case study, ethnography, action research and grounded theory (Figure 4.2).

Figure 4.2 Qualitive methodologies by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Descriptive: A descriptive qualitative study attempts to systematically describe a situation, problem, phenomenon, service or programme. It focuses on discovering the who, what, and where of events or experiences and gaining insights from informants regarding a poorly understood phenomenon.[12] It is also used when more information is required to aid the development and refinement of questionnaires in research projects aiming to gain firsthand knowledge of patients', relatives' or professionals' experiences with a particular topic.[13] This is a good choice for beginner qualitative researchers doing exploratory studies. It uses purposive or convenience sampling, with in-depth interviews as the most common data collection method.[14] Data analysis for this type of qualitative research focuses on a rich descriptive summary of the characteristics (themes) of the phenomena with some interpretation.[14] An example is the study by Cao et al. 2022 that explored the state of education regarding end-of-life care from the perspectives of undergraduate nurses. The findings showed that the undergraduate curriculum related to end-of-life care was disjointed and cultural attitudes toward disease and death impede the undergraduate nurses' learning and knowledge translation of end-of-life care.[15]

Phenomenology is also commonly used in qualitative research, and it is a research approach that seeks to understand the essence of a particular phenomenon through a detailed exploration of individual experiences. It is especially beneficial for exploring personal experiences such as

emotions, perceptions, and awareness.that is especially beneficial for exploring personal experiences such as emotions, perceptions, and awareness.[16] It involves in-depth conversations on a specific topic, captures the relationships between people, things, events and situations and describes and explains phenomena from the perspective of those who have experienced it.[17] It explores the dimensions of participants' experiences.[18] It seeks to understand problems, ideas, and situations in terms of shared understandings and experiences rather than differences.[19] Phenomenological research often employs in-depth, unstructured or semi-structured interviews as a means of data collection.[20] Data analysis typically involves identifying the essential structure or meaning of the experience being studied and then describing it in a way that is understandable to others. The researcher uses a process called the transcendental-phenomenological reduction to bracket off or set aside any preconceived notions of the phenomenon being studied.[21] In this method, researchers use theme analysis to focus on the attributed meaning of participants' lived experiences rather than influencing findings with their own beliefs.[21] This process allows the researcher to gain a deeper understanding of the phenomenon's essence as it is lived and experienced by participants.[21] For example, Liao et al. 2021 conducted a study exploring what medical learners experience through narrative medicine and the meanings they ascribe to narrative-based learning. The study identified six themes: feeling hesitation, seeking guidance, shifting roles in narratives, questioning relationships, experiencing transformation, and requesting a safe learning environment.[22]

Narrative inquiry: Narrative inquiry is qualitative research that seeks to understand how individuals make meaning of their lives and the world around them through studying their stories and experiences.[23] This qualitative research focuses on marginalised populations, usually individuals or small groups and aims to give voice to their perspective.[24] This approach helps people learn more about the participants' culture, historical experiences, identity, and lifestyle and is often recorded as a biography, life history, artifacts or traditional story.[25] It captures a wealth of story data, including emotions, beliefs, images, and insights about time. It also considers the relationship between personal experience and the wider social and cultural context.[24] Importantly, it also involves joint investigation and joint meaning-building between participants and researchers.[26] A major benefit of narrative inquiry is that it involves storytelling, and because humans are natural storytellers, the approach makes it easy to elicit stories.[24] Additionally, it facilitates the creation and construction of data through narratives of lived experience and fosters meaning formation, thus providing valuable insight into the complexities of human life, culture, and behavior.[11] This makes it possible to gather in-depth meaning as participants usually reveal themselves in their stories.[27] Narrative inquiry entails collecting data in the form of stories or narratives through interviews, written or visual materials, or other kinds of self-expression.[24] Data analysis in narrative inquiry involves identifying the themes,

patterns, and meaning of the stories under consideration and understanding how the stories are formed and related to the individual's experiences and perspective.[24] An example is the study by Gordon et al. 2015 which explored medical trainees' experiences of leadership and followership in the interprofessional healthcare workplace.[28] The findings showed that participants most often narrated experiences from the position of follower.[28] Their narratives illustrated many factors that facilitate or inhibit the development of leadership identities.[28] Traditional medical and interprofessional hierarchies persist within the healthcare workplace, and wider healthcare systems can act as barriers to distributed leadership practices.[28]

Case Study aids holistic exploration of a phenomenon. It provides powerful stories within social contexts through various data sources. It undertakes the exploration through various lenses to capture continuity and change and reveal multiple facets of the phenomenon.[29] It is an explanatory, descriptive or exploratory analysis of a single case example of a phenomenon. Case study aids researchers in giving a holistic, detailed account of a single case (or more) as it occurs in its real-life context.[30] The purpose of a case study is to understand complex phenomena and to explore new research questions in a real-world setting.[29] There are three main types of qualitative case study design: intrinsic case study, instrumental case study and collective case study.[31] An intrinsic case study is often conducted to learn about a one-of-a-kind phenomenon.[31] This type of case study focuses on a single case or a small number of cases and explores a specific phenomenon or issue in depth.[30,31] The researcher needs to define the phenomenon's distinctiveness, which separates it from all others. In contrast, the instrumental case study employs a specific instance (some of which may be superior to others) to acquire a more extensive understanding of an issue or phenomenon.[30,31] An instrumental case study uses a single case or a small number of cases to explore a broader research question or problem.[31] The collective case study researches numerous instances concurrently or sequentially to obtain a more comprehensive understanding of a specific subject.[30,31] This type of case study analyses multiple cases to understand a phenomenon or issue from different perspectives.[31] The data collection techniques used in a case study include interviews, observations, or written or visual materials. Data can be collected from various sources, including the case, documents or records, and other relevant individuals. In a case study, data analysis is often inductive, which means that the researcher begins with the data and generates themes, patterns, or insights from it. To examine the data, the researcher may employ a range of approaches, such as coding, memoing, or content analysis. An example of a case study is the study by Lemmen et al. 2021, which aimed to provide insight into how adopting positive health (PH) in a general practice affects primary care professionals' (PCP) job satisfaction.[32] The findings of the study identified three themes regarding PCPs' adoption of PH and job satisfaction, namely adopting and adapting Positive Health, giving substance to Positive Health in

practice, and changing financial and organisational structures.[32] Thus, the PCPs adopted PH, which supported PCPs to express, legitimise, and promote their distinctive approach to care work and its value.[32] PH also enabled PCPs to change their financial and organisational structures, freeing time to spend on patients and their own well-being. The changes made by the practice increased the job satisfaction of the PCPs.[32]

Ethnography is the study of culture and entails the observation of details of everyday life as they naturally unfold in the real world. It is commonly used in anthropological research focusing on the community [33]. It generally involves researchers directly observing a participant's natural environment over time.[33] A key feature of ethnography is the fact that natural settings, unadapted for the researchers' interests, are used. In ethnography, the natural setting or environment is as important as the participants, and such methods have the advantage of explicitly acknowledging that, in the real world, environmental constraints and context influence behaviours and outcomes.[34] Ethnography focuses on the lived culture of a group of people, that is, the knowledge they use to generate and interpret social behaviour.[35] Ethnography often involves a small number of cases or a community, ethnic or social groups. The researcher enters the lived experience of participants in the field and spends considerable time with them to understand their way of life. This research approach increases the strength of the data.[35] An example of ethnographic research is the study by Hinder and Greenhalgh, 2012. The study sought to produce a richer understanding of how people live with diabetes and why self-management is challenging for some. The study revealed that self-management involved both practical and cognitive tasks (e.g. self-monitoring, menu planning, medication adjustment) and socio-emotional ones (e.g. coping with illness, managing relatives' input, negotiating access to services or resources).[36] Self-management was hard work and was enabled or constrained by economic, material and socio-cultural conditions within the family, workplace and community.[36] Although this study is old, it provides insight into some of the challenges associated with diabetes.[36] While more devices have helped with diabetes in recent years, some of these challenges may still exist.

Action Research involves a cyclical process of planning, action, observation, and reflection to improve practice or address a problem. It attempts to understand and improve the world via change.[37] The goal of action research is to generate new knowledge and understanding about a specific issue while at the same time taking action to improve the situation.[37] Action research is guided by the desire to take action, so it is not a design. A type of action research is participatory action research.[38] At its core, this is a collaborative, self-reflective enquiry undertaken by researchers and participants to understand and improve upon the practices in which they participate and the

situations in which they find themselves.[38] The goal is for the participant to be an equal partner with the researcher.[39] The reflective process is inextricably tied to action, impacted by knowledge of history, culture, and the local context, and is rooted in social connections.[38] It is an inquiry process used to understand and improve complex social systems, such as organisations, communities, or classrooms.[40] Participatory action research draws on qualitative methods such as interviews and observation to inquire about ways to improve the quality of practice.[41] The study by Doherty and O'Brien, 2021 explored midwives' understandings of burnout, professionally and personally, in the context of contemporary maternity care in Ireland.[42] Multiple factors influenced midwives' views and understandings of burnout. PAR provided a platform for midwives to examine their ideas and views on burnout with the collaborative support of their midwifery colleagues, via cycles of action and reflection, which is necessary to develop and maintain change. Midwives characterised burnout as continuous stress and tiredness, with an accompanying decline in their coping capacities, motivation, empathy, and/or efficacy. Burnout is unique to the person and is primarily induced and irrevocably tied to excessive workload in midwifery.[42]

Grounded theory first described by Glaser and Strauss in 1967, is a framework for qualitative research that suggests that theory must derive from data, unlike other forms of research, which suggest that data should be used to test theory.[43] It is a qualitative research process that entails developing theories based on evidence that has been collected from the participants.[43] Grounded theory may be particularly valuable when little or nothing is known or understood about a problem, situation, or context.[44] The main purpose is to develop a theory that explains patterns and correlations in data and may be utilised to understand and predict the phenomenon under investigation. This method often entails gathering data through interviews, focus groups, questionnaires, surveys, transcripts, letters, government reports, papers, grey literature, music, artefacts, videos, blogs and memos, then analysing it to identify patterns and relationships.[45] Data is analysed via inductive analysis; the researcher starts with observations and data and then builds hypotheses and insights based on the data. In addition, a continual comparison technique is employed, which entails comparing data repeatedly to identify patterns and themes.[46] Furthermore, open, axial and selective coding is used. Open coding divides data into smaller chunks and classifies them based on their qualities and relationships.[47] In axial coding, links between categories and their subcategories are examined with respect to data.[47] Through "selective coding," all categories are brought together around a "core" category, and categories requiring further explanation include descriptive information. This type of coding is more likely to occur in the final stages of study.[47] An example is the study by Malau-Aduli et al., 2020; the study had two main aims – (1) to identify the factors that influence an International Medical Graduate's (IMG) decision to remain working in regional, rural,

and remote areas; (2) to develop a theory, grounded in the data, to explain how these factors are prioritised, evaluated and used to inform a decision to remain working in RRR areas.[48] The findings revealed that the IMG decision-making process involved a complex, dynamic, and iterative process of balancing life goals based on life stage. Many factors were considered when assessing the balance of three primary life goals: satisfaction with work, family, and lifestyle. Another example is the study by Akosah-Twumasi et al. 2020 which explored the perceived role of sub-Saharan African migrant parents living in Australia in the career decision-making processes of their adolescent children.[49] The study showed that the majority of SSA immigrant parents continued to parent in the same manner as they did back home.[49] Interestingly, some parents modified their parenting approaches due to their perceptions of the host nation.[49] However, due to their apparent lack of educational capacity to educate their children, other parents who would otherwise be authoritative turned into trustworthy figures.[49]

4.4 SAMPLE SIZE AND SAMPLING TECHNIQUES

While there are no set guidelines to determine sample size in qualitative research, the ideal sample size depends on the questions being asked, the theoretical framework, the study design, the type of data that is gathered, the available resources, and the amount of time.[50] Some qualitative studies may involve only a single case, while others may involve a small number of cases, such as a few individuals or groups. The goal of a qualitative study is not to generalise the findings to a larger population but rather to provide a detailed and in-depth understanding of the specific case or cases being studied. A sufficient sample size in qualitative research is one that allows for the detailed, case-oriented analysis that is a characteristic of all qualitative enquiry but also not too small to result in a novel and deeply nuanced knowledge of experience.[50] The minimum number and types of sample units needed in qualitative research cannot be predetermined using calculations or power analyses.[50] Rather, the basic methodological principle in qualitative research is to achieve saturation, which means you keep sampling until you stop learning new details or insights about the phenomenon under investigation.[51] The concept of saturation originated from grounded theory but is now accepted across various approaches in qualitative research. In general, you should keep asking participants until the area of interest is saturated and until you hear nothing new.[43,51] The number of participants, therefore, depends on the richness of the data. A systematic review of empirical results showed that qualitative studies that had 9-17 interviews or 4-8 focus group discussions reached saturation.[52] Nonetheless, the sampling technique is essential given that data cannot be obtained from everyone in the population.

There are four major sampling techniques:

- Purposive sampling is also known as purposeful or selective sampling. It entails the deliberate, purposeful recruitment of individuals who can offer in-depth, precise details on the topic being studied.[53] There are numerous purposive sampling techniques. Examples include typical, extreme or deviant, critical, maximum variation and homogenous sampling.[54] Typical case highlights or illustrates what is normal, typical or average in a case. The purpose is to describe what is typical to those who are unfamiliar with the concept or phenomenon.[54] Extreme or deviant is used when researchers want to explore deviations or outliers from the norm regarding a particular subject.[54] On the other hand, a critical case involves exploring one case to provide insight into other similar cases.[54] The maximum variation sampling technique is used if the research aims to uncover core and shared elements/ themes that cut across a diverse sample while simultaneously offering the opportunity to identify divergent opinions.[54] In contrast, homogenous sampling focuses on people of similar backgrounds and experiences. It reduces variation and is mainly used for focus group discussions.[54] An example of purposive sampling is the study by Adu et al., 2019 which investigated the common gaps in skills and self-efficacy for diabetes self-management and explored other factors which serve as enablers of and barriers to achieving optimal diabetes self-management.[55] The study utilised a maximum variation purposive sampling technique to recruit participants into the study.[55] Figure 4.3 illustrates purposive sampling, where researchers wish to explore the perceptions of people living with diabetes. Diabetic patients were approached and recruited into the study.

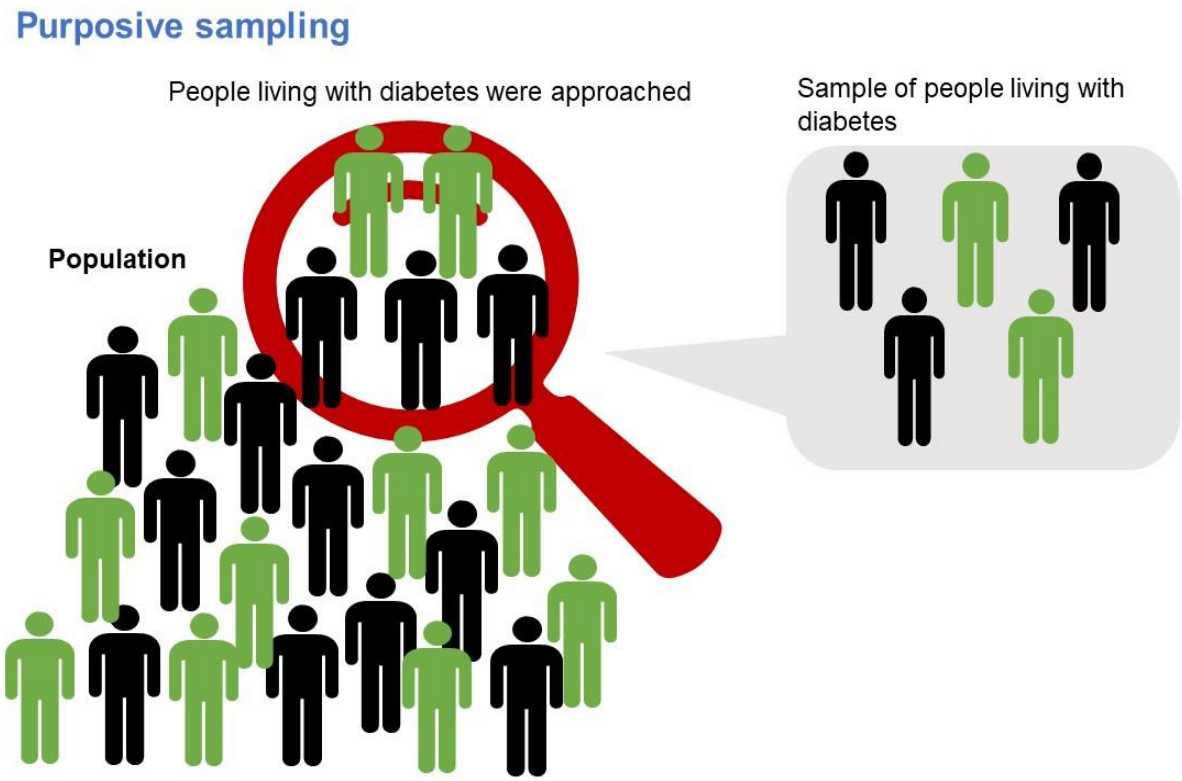

Figure 4.3 Purposive sampling by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- Convenience sampling is a technique used to recruit participants who are representative of the population from which they are selected but chosen because they are easily accessible and convenient to the researchers rather than being randomly selected.[56] Often this may include utilising geographic location, association with a facility/contact and resources that make participant recruitment convenient (Figure 4.4).[56] This sampling technique saves time and effort but has low credibility.[56] While convenience sampling is used in qualitative research, it can also be utilised in quantitative research, as stated in Chapter 3. In addition, it can also be used in mixed methods research which will be discussed in Chapter 5. For example, this study by Obasola and Mabawonku, 2018 used convenience sampling to select 1001 mothers attending maternity clinics at health facilities in Nigeria.[57]

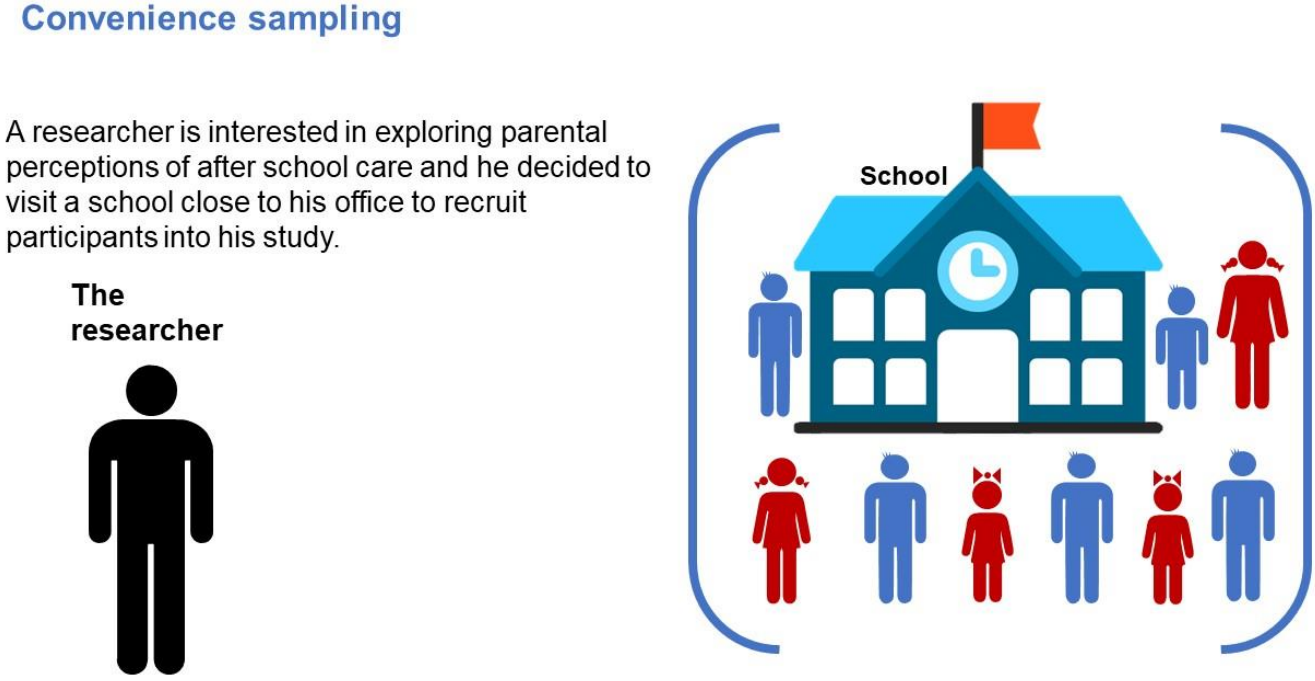

Figure 4.4 Convenience sampling by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

- Theoretical sampling is a data collection process controlled by a theory generation process.[43] It involves the simultaneous collection, coding and analysis of data to identify the next stage of data collection and where to find the participants to develop the emerging theory.[43] It is the principal strategy for the grounded theory approach.[43] According to theoretical sampling, new goals for data collection are determined by the information gathered from the previous sample. It entails seeing emerging ideas in the data that is being produced and using those ideas to direct where, how, and from whom more data should be gathered and with what emphasis.[46] For example, the study by Ligita et al. 2019 utilised theoretical sampling in the study that sought to generate a theory to explain the process by which people with diabetes learn about their disease in Indonesia.[58] The study was conducted in three phases, with a total of twenty-six participants. In the first phase, participants were recruited via purposive sampling, and data from the first phase led to further data gathering. Theoretical sampling was used to select the next data from 17 participants based on the data analysis [58]. Phase three was directed via theoretical sampling, with two new participants recruited into the study.[58] In Figure 4.5, two examples of how theoretical sampling was used in the study have been highlighted.[59]

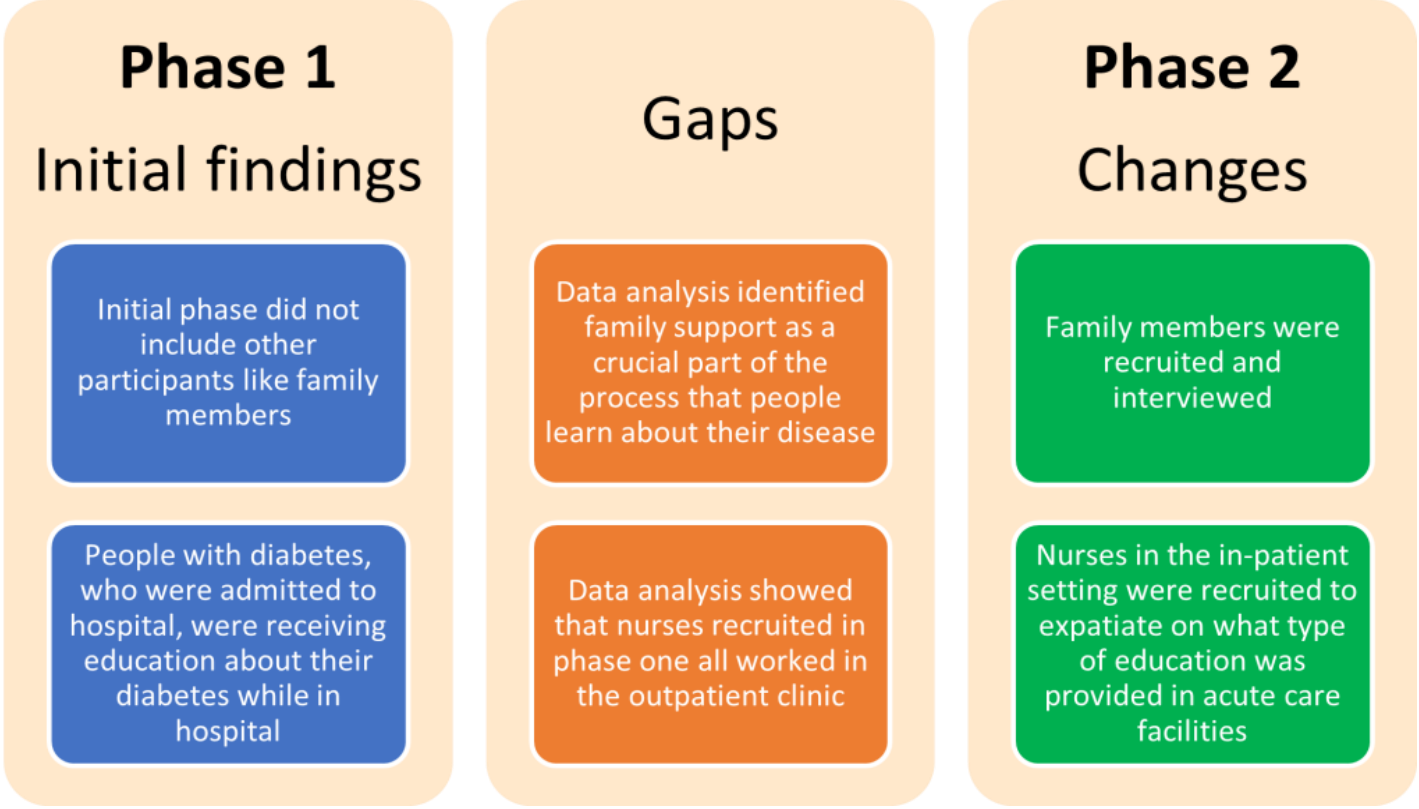

Figure 4.5 Examples of theoretical sampling by Bunmi Malau-Aduli and Faith Alele. Adapted from Ligita et al. 2020, used under a CC BY NC 4.0 licence

- Snowball sampling – This technique is used when it is hard to reach potential participants e.g. members of minority groups. The researcher initially contacts a few potential participants and asks them to provide contact details of people or refer people they know who meet the selection criteria.[60] These identified or named individuals are then recruited into the study. A simple way to consider this technique is to think of how a small snowball rolls down a hill and gets bigger as it gathers more snow.[60] An example is the study by Kaplan, Korf and Sterk, 1987 which describes the temporal and social contexts of Heroin-using populations in two Dutch cities.[61] While the article may be several years old, the graphical presentation and description of the snowballing technique are still valid (Figure 4.6).[61]

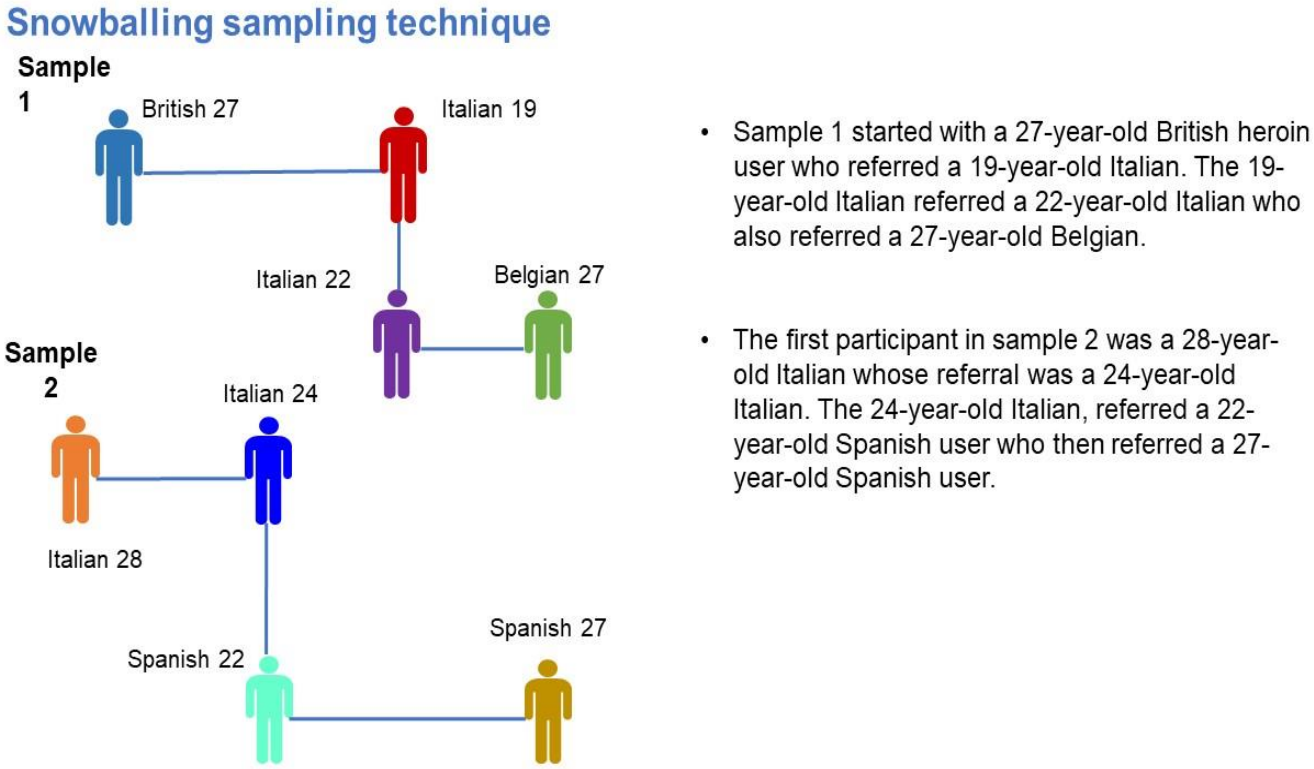

Figure 4.6 Snowballing sampling technique by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence. Adapted from Kaplan, Korf and Sterk, 1987[61]

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4.5 DATA COLLECTION METHODS

Choosing the most appropriate and practical data collection method is an important decision that must be made carefully. It is important to recognise that the quality of data collected in a qualitative manner is a direct reflection of the skill and competence of the researcher. Advanced interpersonal skills are required, especially the ability to accurately interpret and respond to subtle participant behavior in a variety of situations. Interviews, focus groups and observations are the primary methods of data collection used in qualitative healthcare research (Figure 4.7).[62]

Figure 4.7 Data collection methods by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Interviews can be used to explore individual participants' views, experiences, beliefs and motivations. There are three fundamental types of research interviews: structured, semi-structured and unstructured.

Structured interviews, also known as standardised open-ended interviews, are carefully prepared ahead of time, and each participant is asked the same question in a certain sequence.[63] A structured interview is essentially an oral questionnaire in which a pre-determined list of questions is asked, with little or no variation and no room for follow-up questions to answers that require further clarification.[63] Structured interviews are relatively quick and easy to develop and use and are especially useful when you need clarification on a specific question.[63] However, by its very nature, it allows only a limited number of participant responses, so it is of little use if "depth" is desired. This approach resists improvisation and the pursuit of intuition but can promote consistency among participants.[63]

Semi-structured interviews, also known as the general interview guide approach, include an outline of questions to ensure that all pertinent topics are covered.[63] A semi-structured interview consists of a few key questions that help define the area to be explored but also allow the interviewer or respondent to diverge and explore ideas or responses in more detail.[64] This interview format is used most frequently in healthcare, as it provides participants with some guidance about what to talk about. The flexibility of this approach, especially when compared to structured interviews, is that it allows

participants to discover or refine important information that may not have been previously considered relevant by the research team.[63]

Unstructured interviews, also known as informal conversational interviews, consist of questions that are spontaneously generated in the natural flow of conversation, reflect no preconceptions or ideas, and have little or no organisation.[65] Such conversations can easily start with an opening question such as, "Can you tell me about your experience at the clinic?" It then proceeds primarily based on the initial response. Unstructured interviews tend to be very lengthy (often hours), lack pre-set interview questions, and provide little guidance on what to talk about, which can be difficult for participants.[63]

As a result, they are often considered only when great "depth" is required, little is known about the subject, or another viewpoint on a known issue is requested.[63] Significant freedom in unstructured interviews allows for more intuitive and spontaneous exchanges between the researcher and the participants.[63.].

Advantages and Disadvantages

Interviews can be conducted via Phone, Face-to-Face or Online, depending on participants' preferences and availability. Often participants are flattered to be asked and they make the time to speak with you and they reward you with candour.[66] Usually, interviews provide flexibility to schedule sessions at the convenience of the interviewees.[66] It also provides less observer or participant bias as other participants' experiences or opinions do not influence the interviewee. Interviews also provide enough talk time for interviewees and spare them from spending time listening to others. Additionally, the interviewer can observe the non-verbal behaviour of the interviewee and potentially record it as data.[66]

Interviews also have inherent weaknesses. Conducting interviews can be very costly and time-consuming. [66] Interviews also provide less anonymity, which is usually a major concern for many respondents.[66] Nonetheless, qualitative interviews can be a valuable tool to help uncover meaning and understanding of phenomena.[66]

With your understanding of interviews, watch this video clip and identify what you would do differently and provide your thoughts in the Padlet below.

After watching the video, reflect on the responses you provided in the Padlet and consider if there is anything you may have missed out or need to revise.

Focus group

Focus groups are group interviews that explore participants' knowledge and experiences and how and why individuals act in various ways.[67] This method involves bringing a small group together to discuss a specific topic or issue. The groups typically include 6-8 participants and are conducted by an experienced moderator who follows a topic guide or interview guide.[67] The conversations can be audio or videotaped and then transcribed, depending on the researchers' and participants' preferences. In addition, focus groups can include an observer who records nonverbal parts of the encounter, potentially with the help of an observation guide.[67]

Advantages and disadvantages

Focus groups effectively bring together homogenous groups of people with relevant expertise and experience on a specific issue and can offer comprehensive information.[67] They are often used to gather information about group dynamics, attitudes, and perceptions and can provide a rich source of data.[67]

Disadvantages include less control over the process and a lower level of participation by each individual.[67] Also, focus group moderators, as well as those responsible for data processing, require prior experience. Focus groups are less suitable for discussing sensitive themes as some participants may be reluctant to express their opinions in a group environment.[67] Furthermore, it is important to watch for the creation of "groupthink" or dominance of certain group members, as group dynamics and social dynamics can influence focus groups.[67]

Observation

Observations involve the researcher observing and recording the behaviour and interactions of individuals or groups in a natural setting.[67] Observations are especially valuable for gaining insights about a specific situation and real behaviour. They can be participant (the researcher participates in the activity) or non-participant (the researcher observes from a distance) in nature.[67] The observer in participant observations is a member of the observed context, such as a nurse working in an intensive care unit. The observer is "on the outside looking in" in non-participant observations, i.e. present but not a part of the scenario, attempting not to impact the environment by their presence.[67] During the observation, the observer notes everything or specific elements of what is happening around them, such as physician-patient interactions or communication between different professional groups.[67]

Advantages and disadvantages

The advantage of performing observations includes reducing the gap between the researcher and the study. Issues may be found that the researcher was unaware of and are relevant in gaining a greater understanding of the research.[67] However, observation can be time-consuming, as the researcher may need to observe the behaviour or interactions for an extended period to collect enough data. In addition, they can be influenced by the researcher's biases, which can affect the accuracy and validity of the data collected.[68]

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4.6 DATA ANALYSIS

When analysing data, qualitative researchers typically use text. The goal of qualitative data analysis is to assemble or reconstruct the data in a meaningful or understandable method that is transparent and rigorous while keeping 'true' to the participants' stories.[69] Although qualitative data analysis is inductive and focused on meaning, methods of data analysis vary in aim and have ontological and epistemological basis.[70] There are two key approaches to analysing qualitative data – inductive analysis and deductive analysis.

- Inductive analysis involves coding data without trying to fit it into a pre-existing coding frame or the researcher's analytic preconceptions.
- Deductive analysis is driven by theoretical interest and may provide a more detailed analysis of some aspects of the data. It tends to produce a less detailed description of the overall data.

Types of qualitative data analysis

There are different data analyses used in healthcare research, including content analysis, discourse analysis, thematic analysis, interpretive phenomenological analysis, narrative analysis and grounded theory analysis. The common ones include content analysis, discourse analysis and thematic analysis, and as beginner researchers, we will focus on these.

- *Content analysis:* is a method of unobtrusively investigating vast volumes of textual material to detect trends and patterns in words used, their frequency, their connections, and the structures and discourses of communication.[71] It transforms qualitative input into quantitative data by quantifying words, messages or concepts and analyses the relationships between the concepts. The goal of content

analysis is to explain the features of the document's content by looking at who says what to whom and to what effect.[72] Content analysis requires that the text be broken down into manageable codes for analysis. The analysis is conducted in the following stages, decontextualization, recontextualization, categorisation and compilation.[73] In the decontextualization stage, the researcher must familiarize themselves with the data (read through the transcribed test) to understand the data before breaking it into smaller meaning units assigned codes.[73] Recontextualisation involves checking that all aspects of the content have been addressed with regard to the aim of the study.[73] The original text is reread with the final list of codes, and any missed relevant text is included. The codes (meaning units) are condensed in the categorisation stage, and themes and categories are identified. In the final stage – compilation, the analysis and writing-up process begin once the categories have been established.[73] Abroms et al. 2011 used content analysis to analyse the content of 47 iPhone applications (apps) for smoking cessation and their adherence to the U.S. Public Health Service's 2008 Clinical Practice Guidelines for Treating Tobacco Use and Dependence.[74] The study found that apps identified for smoking cessation had low levels of adherence to key guidelines in the index.[74]

- *Discourse analysis:* investigates language in use instead of psychological factors such as attitudes, memories, or emotions.[75] Language is studied in discourse analysis in terms of construction and function and is viewed as a tool for producing reality. Thus, discourse analysis investigates how particular concerns are produced in people's narratives and the variety in these accounts to examine the link between language and social reality.[76] Discourse analysis can be used in health care to analyse interpersonal communication processes between doctors or nurses and patients, interprofessional conversation and in-depth interviews about lay health beliefs.[76,77] The article by Brooks et al. 2019, utilised discourse analyses as one of the analytical strategies to analyse the relationships and relationality with companion animals as therapeutic agents in the context of people's wider social networks.[78]

- *Thematic analysis:* is a technique for finding, examining, classifying, and reporting themes in data collection.[79] It involves identifying codes or units of analysis that emerge from the data. Thematic analysis is the most common form of qualitative data analysis.[79] It offers a flexible analytic strategy that may be adjusted to suit the objectives of numerous studies, offering a detailed and intricate description of the data.[79] Six phases have been identified in the thematic analysis and include familiarizing yourself with your data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.[79] The process is iterative and reflective and evolves, constantly moving back and forth between the phases. For researchers early in their research career, thematic analysis offers a more approachable analysis, as it does not demand the

in-depth theoretical and technological understanding that other qualitative techniques entail.[79] An example is the study by Danielson et al. 2015, which used thematic analysis to identify common concerns facing pharmacy experiential education (EE) programs.[80] The themes identified were site capacity, workload/financial support, quality assurance, preceptor development, preceptor stipends, assessment, onboarding, and support/recognition from the administration.[80]

4.7 QUALITATIVE RIGOUR

Qualitative research is sometimes crticised for being biased, small scale, anecdotal, and/or lacking rigour; but, when done properly, it is impartial, in-depth, valid, dependable, believable, and rigorous. Similar to quantitive research, where validity and reliability are assessed, qualitative research may be evaluated for trustworthiness.[81] Criteria used to establish trustworthiness include credibility, transferability, confirmability, and dependability.[81]

- *Credibility:* refers to the degree to which the findings of a study are believable, trustworthy, and accurate.[81,82] The "fit" between respondents' opinions and the researcher's depiction of them is addressed by credibility. There are a variety of approaches to address credibility, including prolonged engagement, persistent observation, data collection triangulation, and researcher triangulation.[82] Peer debriefing to give an external check on the study process has also been identified to increase credibility. Another way is via member checking, which involves testing the results and interpretations with the participants.[82]
- *Transferability:* refers to the extent to which the findings of the study can be applied to other settings and contexts.[81] In other words, transferability refers to the generalizability of the study. While the researcher cannot know which sites may desire to transfer the findings, the researcher must provide detailed descriptions so that people who wish to transfer the results to their own location may assess transferability.[82]
- *Confirmability:* refers to the degree to which the research findings are objective and not influenced by the researcher's biases or beliefs.[81] It is concerned with demonstrating that the researcher's interpretations and findings are drawn from the data, which necessitates the researcher demonstrating how conclusions and interpretations were reached.[83] For people to comprehend how and why decisions were taken, researchers need to incorporate markers like the justifications for theoretical, methodological, and analytical choices throughout the study.[84]
- *Dependability:* refers to findings that are consistent and sustainable over time.[81] Researchers need to ensure the study process is rational, traceable, and thoroughly recorded. Readers are better equipped to assess the reliability of the study when they can see how the research was conducted.[82,83]

In the Padlet below, use a mind map to articulate your thoughts on a particular research of interest to you in your discipline/field of study.

4.8 CONCLUSION

The focus of this chapter is on the characteristics, benefits and types of qualitative research methodologies. The take-home messages, as highlighted in the opening scenario, emphasise the importance of conducting qualitative research. Sophie's assumption that a high number of people accepting the free ice cream offer indicated satisfaction with the new flavour was proven incorrect when she conducted qualitative research and found out that people accepted the offer primarily because the ice cream was free.

Qualitative research involves gathering non-numerical data through methods such as interviews, focus groups, and observations. It provides an in-depth understanding of people's experiences, perspectives, and attitudes towards a specific subject matter. In this scenario, Sophie's decision to conduct interviews with the participants who accepted the free ice cream offer helped her to gain deeper insights into their preferences and perceptions.

Overall, the scenario illustrates the importance of qualitative research methods to obtain a more comprehensive understanding of healthcare stakeholders' preferences and behaviours. While quantitative data provides valuable information about people's behaviour, attitudes, and preferences, qualitative research provides insights into the reasons behind those behaviours and attitudes and can help inform the development of more effective intervention strategies and health outcomes.

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5. MIXED METHODS

"We need to marry the qualitative with the quantitative. It better informs us so we can decide what to do. We can't be afraid of data and analysis. We have to use that lens." – Nathan Shedroff

In this chapter you will learn about:

- the purpose of mixed methods
- types of mixed methods research
- sampling techniques in mixed methods
- triangulation of data.

Opening Scenario

It was Stephanie's birthday, and her best friend (Joane) decided to take her to the new Japanese restaurant in town for dinner. Stephanie was thrilled, but she had some difficulty choosing between her two favourite dishes – Sukiyaki (a traditional Japanese dish of thinly sliced beef and other ingredients cooked over a flame in a pot known as a "suki") and Tonkatsu (a traditional Japanese dish that consists of a breaded and deep fried pork cutlet which is served with various toppings). Joanne then suggested that they order both dishes and share the meals. That way, Stephanie could have and enjoy a bit of 'both dishes -worlds". Joane's solution to Stephanie's dilemma can be likened to what happens in mixed methods research.

No wonder Nathan Shedroff said, "We need to marry the qualitative with the quantitative. It better informs us so we can decide what to do."

5.1 PURPOSE OF MIXED METHODS

Mixed methods design is a research design that combines both quantitative and qualitative research methods in a single study to gain a more comprehensive understanding of a phenomenon. It strategically combines and integrates quantitative and qualitative research methods in a single research study to take advantage of the best of both worlds.[1] This approach involves the intentional collection and analysis of both quantitative and qualitative data, which are triangulated to validate results. Mixed methods research aims to maximise the strengths of quantitative and qualitative research methods, combining inductive and deductive reasoning to gain a more comprehensive

understanding of health research questions. Mixed methods are especially useful in complex research environments where a single method may not be sufficient to fully understand the problem at hand. Mixed methods can balance the limitations of quantitative and qualitative research, create robust descriptions and interpretations of data, make quantitative results more understandable, and increase the broad applicability of qualitative results from small samples.[2]

5.2 RATIONALE FOR USING MIXED METHODS

Recent evidence in the published literature confirms that mixed methods can be effectively used in various health-related research settings, ranging from the clinical to the social context of everyday activities and relationships.[3,4] This approach helps to adequately address public health issues, including environmental and behavioural factors that cause health disparity in populations, poor access or adherence to medical care, and lack of translational health research.[5-7] A growing acceptance of qualitative and social science research, the formation of interdisciplinary research teams, and multilevel approaches to study complex health problems have enhanced interest in mixed methods research.[8] In addition, the increasing methodological sophistication of mixed methods research in the social and behavioural sciences has contributed to this interest.[9] Researchers use research approaches such as in-depth interviews, field observations, and patient records to understand individual experiences, participant involvement in interventions, treatment barriers and facilitators. These approaches are often combined with clinical research, attitude and belief surveys, and epidemiological measurements to understand health problems.[10] On the whole, mixed methods provide multiple perspectives to enhance and enrich the meaning of phenomena.

There are several reasons for using a mixed-methods design: expansion, complementarity, development, completeness, compensation, corroboration/confirmation, and diversity (Figure 5.1).[11]

1. Expansion of the study: This implies that a mixed methods research approach enables researchers to broaden their investigation with adequate depth and breadth.
2. Complimentary methods: Combining two methods will produce a holistic picture that allows for complementary or divergent views.
3. Development: using the implications of one method to construct questions for another technique or using one method to propose hypotheses to be tested in a subsequent method.
4. Triangulation: refers to the corroboration, convergence and confirmation of findings from the different methods
5. Initiation: entails obtaining divergent or contradictory perspectives on the same concept or phenomenon using different methods leading to new views on frameworks.

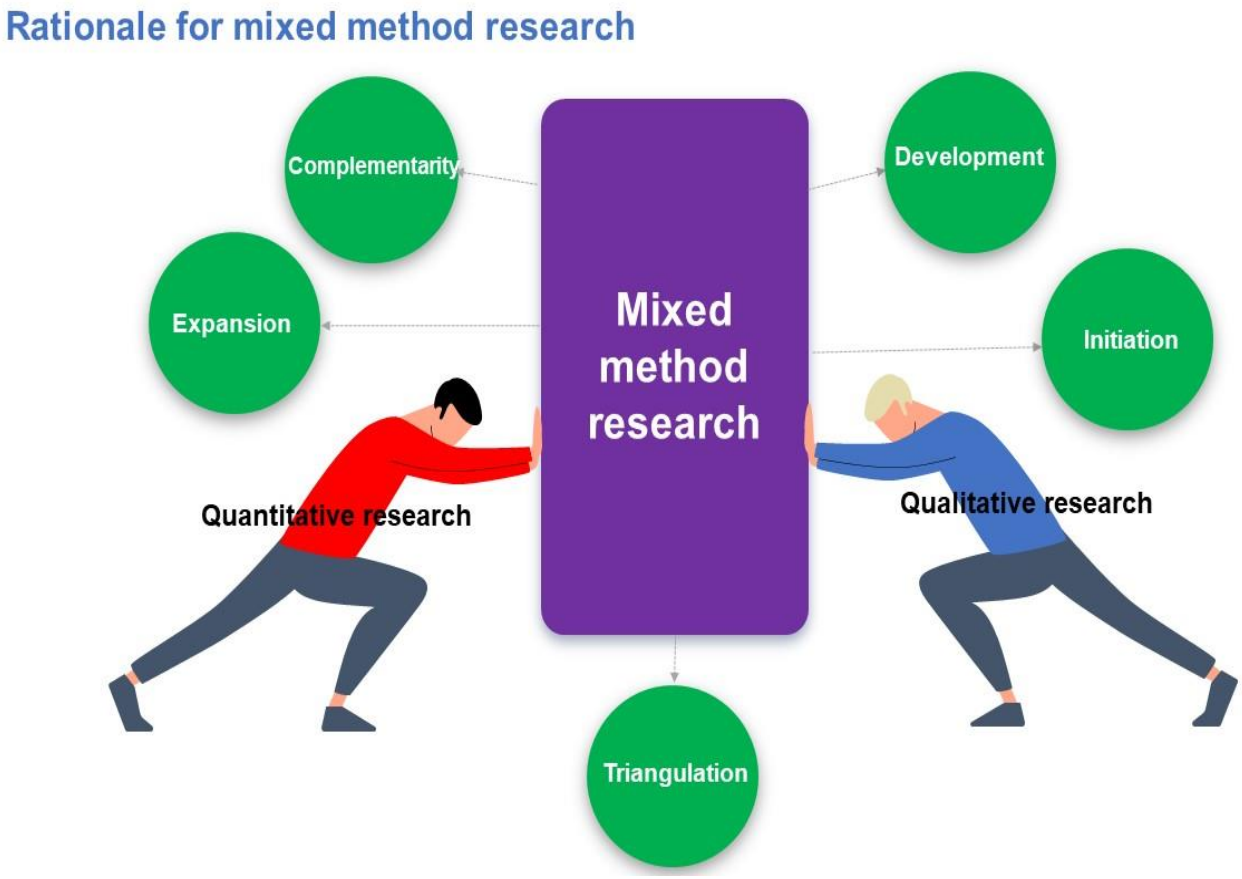

Figure 5.1 Rationale for mixed method research by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

5.3 KEY ATTRIBUTES OF MIXED METHODS RESEARCH

Listed below are the five key attributes or characteristics of mixed methods research design.[12]

- Collection and analysis of both quantitative and qualitative data
- The procedure is framed within philosophical worldviews or theoretical lenses
- It utilises research designs that match the research question
- It involves the integration or mixing of the two forms of data (merges, builds, or embeds)
- It involves rigorous processes when using both forms of data

Remember the opening scenario about Stephanie and Joane deciding to order both Sukiyaki and Tonkatsu and share the meals? How do you think the scenario can be likened to mixed methods research in relation to these key attributes?

General steps for conducting mixed methods research

While there are no hard and fast rules for designing a mixed-methods study, the general steps below (Figure 5.1) should provide some guidance, especially for researchers who are new to mixed methods studies.[13]

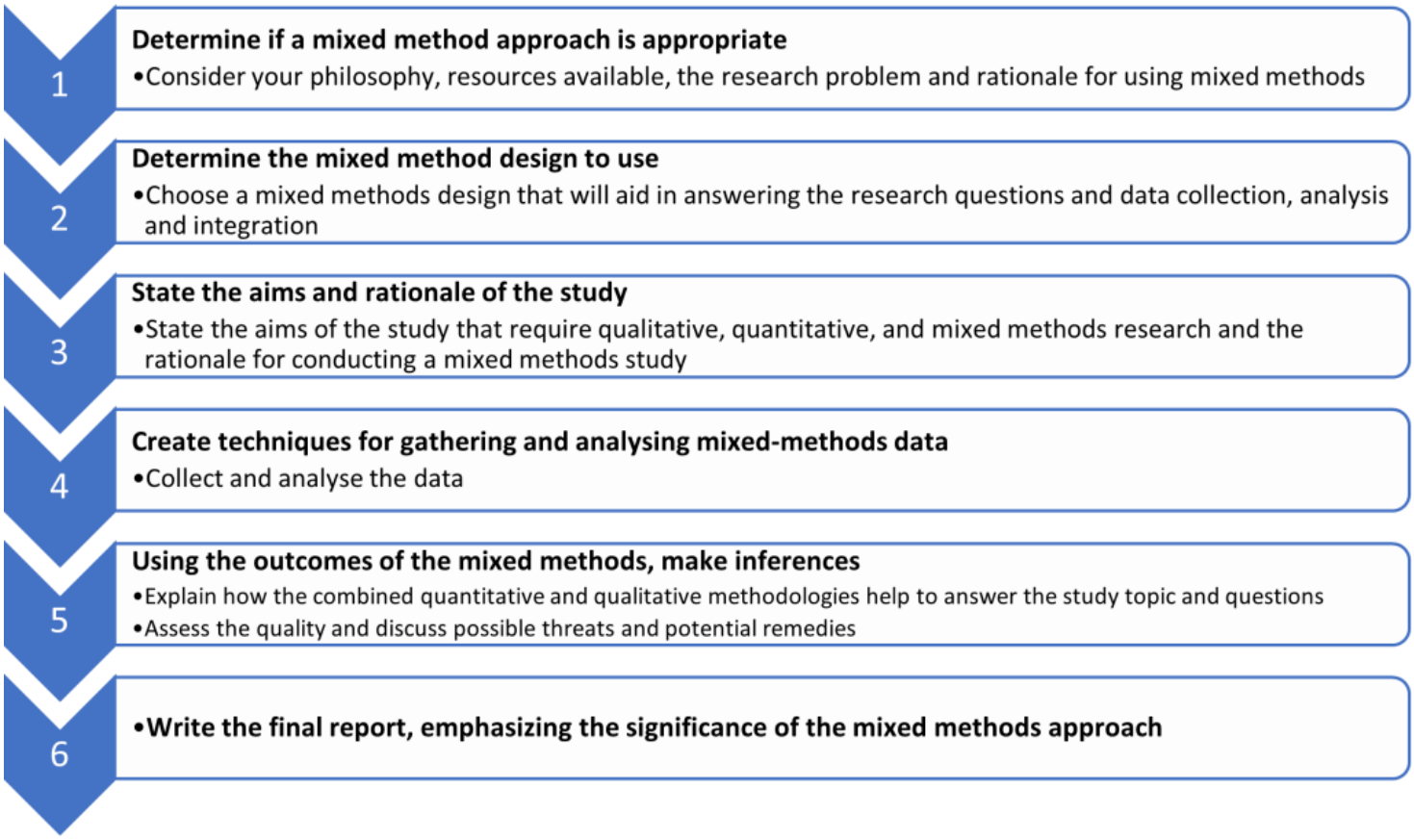

Figure 5.2 Steps for conducting mixed method research by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

5.4 PHILOSOPHICAL UNDERPINNINGS TO MIXED METHODS RESEARCH

As discussed in Chapter 1, a research methodology needs a philosophical and epistemological underpinning, i.e. what is the nature of the knowledge you are trying to uncover? From a philosophical standpoint, quantitative research (scientific method) is conducted from a deductive point of view, and is based on a probabilistic interpretation of reality, positivism or post-positivism. A (post)positivist tenet is the belief that there is an objective world in which research and discovery are possible.[14] This method aims to minimize the researchers' influence on the data source and reduces subjectivity from skewing the conclusions.[15] On the other hand, qualitative research allows

investigation from an inductive perspective and is based on constructivist or interpretivist principles.[16] This paradigm recognizes the possibility of multiple perspectives on reality, knowledge is not value-free, and that subjectivity is a necessary element of investigation.[16] Mixed-methods researchers combine paradigms that allow investigation from inductive and deductive perspectives to combine theory-building and hypothesis testing in a single study.[17] This approach is centred on the cyclical interplay of beliefs and actions.[18] There are two major philosophical positions in which mixed methods research might be grounded – Pragmatism and Realism. These positions are often referred to as dialectal stances that bridge postpositivist and social constructivist worldviews, pragmatic and transformative perspectives.[11] A pragmatic perspective draws on employing "what works," using diverse approaches, prioritising the importance of the research problem and question, and valuing objective and subjective knowledge.[15,19] Realist approaches developed mainly in response to a perceived need for research that was useful to policymakers, asking questions about what goes on beneath the surface in these socially complex situations. [20,21] Nonetheless, calls have been made to embrace pragmatism as the best philosophical foundation for mixed methods research.[22]

Sample size estimation and sampling technique

Sample size estimation and sampling techniques for quantitative and qualitative research have already been discussed in previous chapters and the same principles apply in mixed methods studies where quantitative and qualitative components are combined. For details on sample size estimation and sampling techniques used in quantitative and qualitative research, please refer to Chapter 3 and Chapter 4, respectively. A summary is provided below to remind you of what we discussed earlier on these topics.

Sample size is an important consideration in mixed methods research, as it pertains to the number of participants or cases included in the study. As discussed in Chapter 3, sample size for quantitative research is determined by the statistical power of the study, which is the probability of detecting an effect of a given size if one exists. [23] Larger sample sizes generally increase the power of a study and reduce the likelihood of Type II errors (failing to reject a null hypothesis that is false). However, sample size also depends on the variability of the outcome, the effect size, and the desired level of confidence. Note that larger sample size improves precision but also increases cost, time, and complexity. As stated in Chapter 4, sample size for qualitative studies is determined by the principle of saturation, which is the point at which new data no longer provide new insights into the research question.[24] For qualitative data, a small sample size is usually sufficient, as the goal is to gain a detailed and in-depth understanding of the research problem. However, sample size also depends on the complexity of the research question and the research setting. On the whole, It is important to note

that the sample size is a trade-off between study accuracy and feasibility. Therefore, it should be determined in a way that is appropriate for the research question and and feasible in terms of resources and time.

Sampling technique refers to the process of selecting participants for a mixed methods study. There are different ways to combine sampling techniques in mixed methods research. For example, a researcher may use a purposive sampling strategy for the qualitative component (see Chapter 4 for details) of the study and a probability sampling strategy for the quantitative component (see Chapter 3 for details). It is important to note that the sampling strategy used should be consistent with the overall research design and the specific research question. Sampling techniques should be feasible in terms of resources and time, ethically sound and appropriate for the research question.

Data collection and analytical methods

Data collection refers to the process of collecting both quantitative and qualitative data as part of a mixed methods study. The data collection methods used will depend on the specific research question and the overall research design. Quantitative data is collected using methods such as surveys, experiments, or observational. These methods often involve structured instruments such as questionnaires or standardized tests. The data is usually numerical and can be analyzed using statistical methods. Quantitative data are usually analyzed using statistical techniques such as descriptive statistics, inferential statistics and multivariate analysis. These methods are used to identify patterns and relationships in the data and draw inferences about the population from which the sample was drawn. Please refer to Chapter 3 for more information on quantitative data collection and analytical methods.

Qualitative data is collected using methods such as interviews, focus groups, or ethnographic observations. These methods often involve unstructured or semi-structured instruments such as open-ended questions or interview guides. The data is usually in the form of words and can be analysed using methods such as content analysis or thematic analysis. Qualitative data are typically analyzed using methods such as content analysis, thematic analysis and discourse analysis. These methods are used to identify patterns and themes in the data and interpret the meaning of the data. For further details on qualitative data collection and analytical methods, please revisit the content covered in Chapter 4.

5.5 MIXED METHODS STUDY DESIGNS

There are diverse reasons why researchers undertake mixed methods research.[10] When researchers commence their study with a quantitative phase before a qualitative phase, often the aim is to use the initial information gathered to identify the best participants who may be recruited in the follow-up qualitative phase or to explain the mechanism behind the quantitative results.[10] For research studies where the quantitative phase follows the qualitative phase, the researcher may develop either a survey instrument, an intervention, or a program informed by the qualitative findings/ evidence. The choice of a mixed methods design should be informed by theoretical and/ or conceptual frameworks that support the study aims/ objectives.[9]

The following mixed methods designs listed below are not exhaustive but only highlight common designs used in health care. Convergent, sequential and embedded are the basic designs, while multiphase goes beyond these basic designs but has been included here for your knowledge.[25] It is important to note that there are more complex designs, and the research question drives them.

Convergent (parallel or concurrent) design: A mixed methods design in which quantitative and qualitative data are collected simultaneously but analyzed separately, and the results are merged or integrated (Figure 5.2).[25] This type of design allows for the collection of rich, detailed data and provides a comprehensive understanding of the research problem.[25] An example of a concurrent mixed method design is the study by Rosenkranz, Wang and Hu., 2015 which aimed to explore, identify and explain what motivates and demotivates medical students to do research. The study used a convergent parallel mixed methods study where quantitative data were collected via a survey and qualitative data via semi-structured interviews. Data were analysed separately, and the results were compared and merged.[26]

The benefit of the convergent mixed methods design used in the study by Rosenkranz et al.,[26] is that it allowed for a more comprehensive and nuanced understanding of what motivates and demotivates medical students to do research by drawing on both types of data. The survey results showed that students who had experienced exposure to the uncertainties of clinical practice through clerkships and supported compulsory research activities, were more likely to view future research activities positively. The semi-structured interviews revealed that these activities were particularly important because they helped the students to see research as a social activity which has clinical relevance and builds confidence. Overall, the study design provided evidence for the motivating effects of

Competence and Relatedness in relation to medical students doing research. In this particular study, the researchers were able to not only identify the factors that motivate and demotivate medical students to do research but also gain an in-depth understanding of why those factors were important. The study design also increased the validity of the research as the limitations of the survey data were addressed by using qualitative data to provide a more in-depth understanding of the research question.

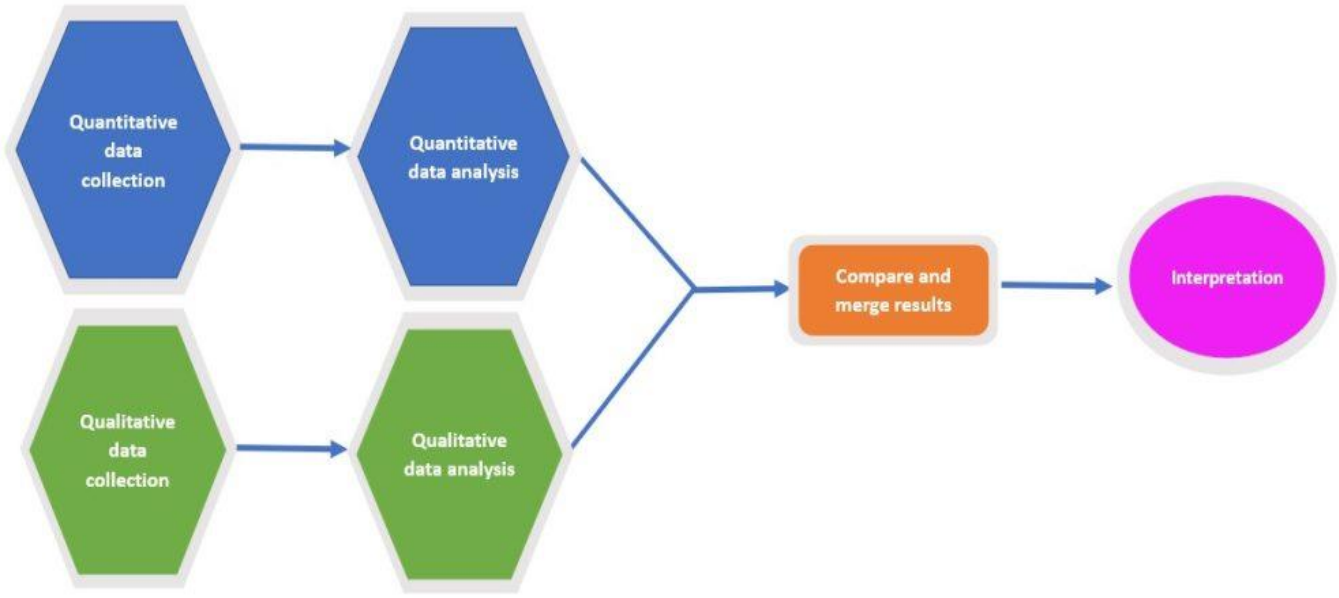

Figure 5.3 Convergent mixed methods design by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 license

Sequential (exploratory or explanatory) designs: In this type of mixed methods design, the aim is to use the results of one method to develop or build another method. These designs may begin with a qualitative method followed by a quantitative approach (exploratory) or a quantitative investigation followed up with a qualitative enquiry (explanatory).[25]

Exploratory sequential design*:* This technique involves the initial collection of qualitative data, and the findings are used to guide the design and development of quantitative data collection tools.[25] The quantitative and qualitative data results are then integrated to provide a more comprehensive understanding of the phenomenon (Figure 5.3). This method is useful when developing and testing a new instrument. An example is the study by Jafer et al., 2020 which investigated dental patients' behaviour, thoughts, opinions and needs for oral cancer information, and dentists' behaviour regarding the prevention and examination of oral cancer.[27] The qualitative methodology was utilised to discover the emerging patterns in the patient's thoughts, opinions and expectations regarding oral

cancer. Following the qualitative investigation, a descriptive quantitative observational study was conducted on a larger sample of dental patients to analyse and quantify oral cancer-related features.[27]

The benefit of using an exploratory sequential design in the study by Jafer et al.,[27] is that it allowed for an in-depth exploration of the dental patients' thoughts, opinions, and needs for oral cancer information, and dentists' behaviour regarding the prevention and examination of oral cancer. By using qualitative methods to explore the emerging patterns in the patients' views and needs, the researchers were able to identify key themes and issues that would have been missed in a purely quantitative study. The subsequent quantitative study, which involved a larger sample of dental patients, allowed the researchers to test and confirm their findings from the qualitative study in a more representative sample. By combining both qualitative and quantitative methods, the researchers were able to gain a more comprehensive understanding of the research problem and provide more nuanced and insightful recommendations for improving oral cancer prevention and examination practices in dental settings.

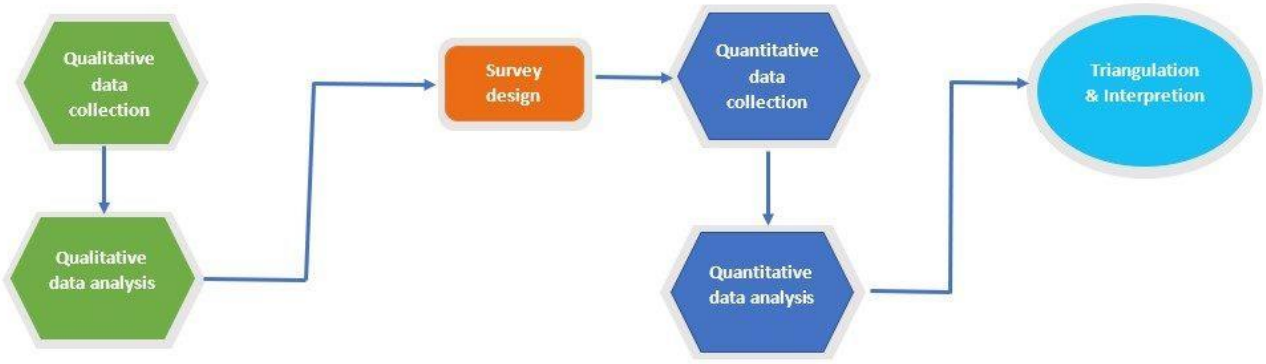

Figure 5.4: Exploratory sequential mixed methods design by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Explanatory sequential design: this method is characterised by the collection and analysis of quantitative data, followed by the collection and analysis of qualitative data.[25] The goal is to use the qualitative findings to explain and interpret the quantitative results (Figure 5.4). This method is popular in health research.[25] An example of explanatory sequential design is the study by Albert et al., 2022 which explored the views of General Practitioners (GPs) and Exercise Physiologists (EPs) as key stakeholders for optimizing patient care and efficiency of physical activity referral schemes (PARS).[28]

The authors used quantitative methods to investigate these health professionals' knowledge, beliefs, and attitudes towards PARS in the first phase of the study. This initial phase provided an overall understanding of the topic, indicated that the participants valued PARS and the findings guided the

development of the interview guide and participant selection for the second (qualitative) phase. In the second phase, the authors used semi-structured interviews to gather in-depth information on participants' perceptions about care coordination through PARS. The qualitative data allowed for a more nuanced understanding of the research question and helped the researchers to identify the key factors that influence the success of PARS. This design helped the authors to develop a robust and accurate understanding of a complex phenomenon and provided insights that can inform the development of interventions and policies to improve patient care and the efficiency of PARS.

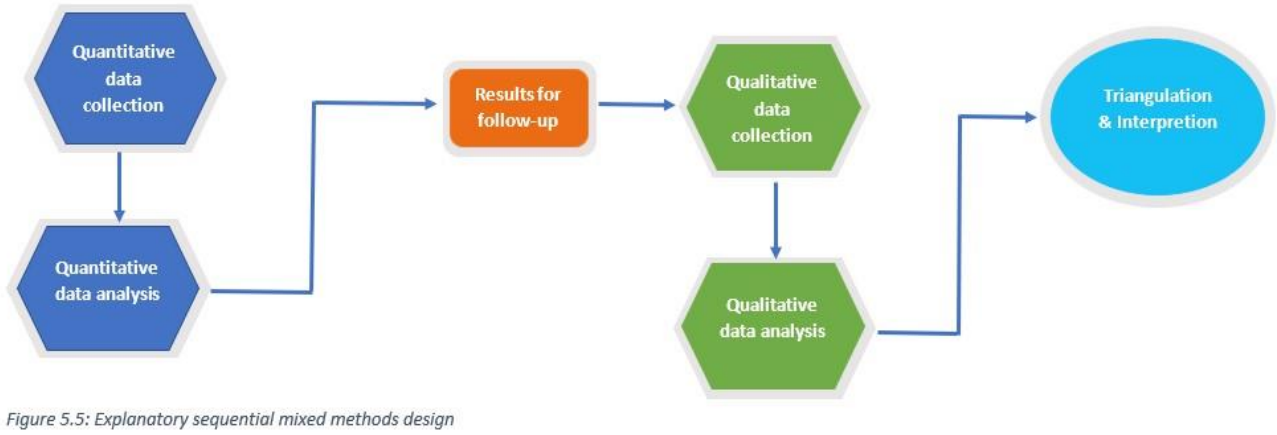

Figure 5.5: Explanatory sequential mixed methods design

Figure 5.5 Explanatory sequential mixed methods design by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Embedded design: This design is also known as nested design.[25] It involves embedding one research design into another to generate new insights (Figure 5.5). Embedded designs may be convergent or sequential.[25] As an illustration, this technique could embed qualitative research within a broader quantitative study.[25] The quantitative study is used to offer a larger understanding of the research problem, whereas the qualitative study provides a more in-depth understanding of specific parts of the research topic.[25] An example is the study by Yue et al., 2022 which aimed to investigate nurses' perceptions and experiences with the transition to a new nursing information system (Care Direct) 2 years after its first introduction. The study used an embedded design in which qualitative data and quantitative data were collected concurrently with the qualitative data given priority.[29]

The embedded mixed methods design allowed the authors to explore both the prevalence of certain attitudes or behaviors and to gain insight into why these attitudes and behaviors were present. The use of qualitative data as a priority in the study allowed the researchers to explore the complexity and richness of the nurses' experiences with the new system. This approach is particularly useful when trying to understand the factors that contribute to or impede successful implementation of new technologies. Additionally, the qualitative data was used to develop a theoretical framework that

informed the development of the quantitative survey instrument. This strategy ensured that the quantitative data collected was grounded in the context of the nurses' experiences with the new system, thereby enhancing the quality and relevance of the research findings.

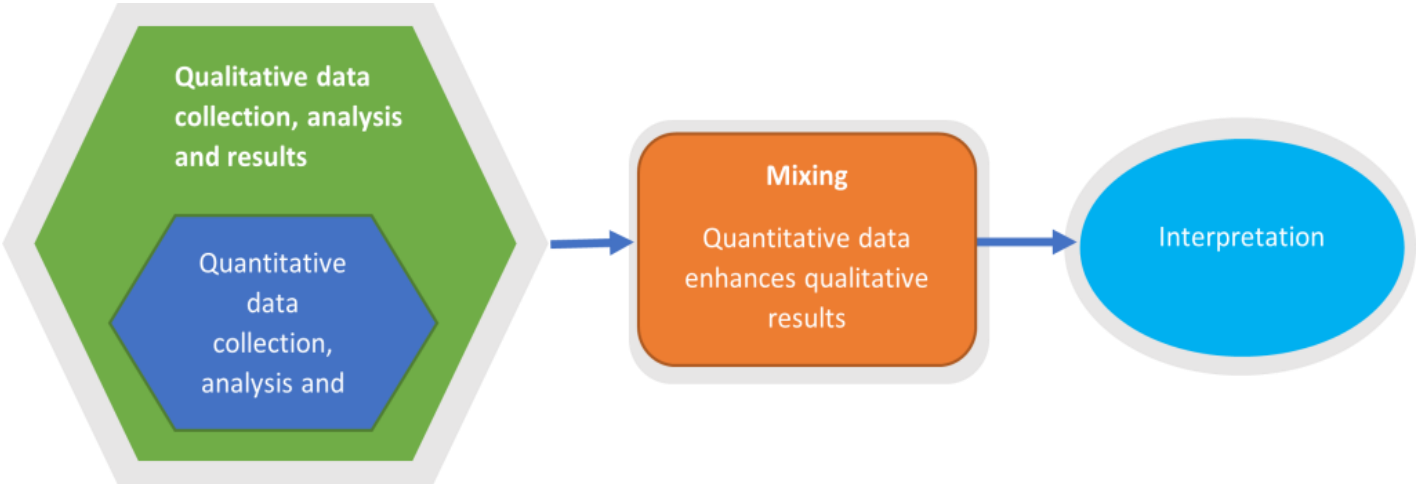

Figure 5.6 Embedded mixed methods design by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Multiphase design: In this approach, multiple projects with a common goal are conducted.[25] This method requires multiple designs to be conducted over time with linkages in place to ensure that each phase builds on the previous one.[25] A project could start with a qualitative design and proceed to a quantitative design, then return to a qualitative design, and so on (Figure 5.6). The design may contain convergent or sequential elements.[25] For example, Lee et al., 2018, conducted a study that sought to evaluate an intervention program – The Prevention and Wellness Trust Fund (PWTF).[30] The program was designed to address hypertension, paediatric asthma, falls among older adults, and tobacco use in Massachusetts. The aim was to improve health outcomes through prevention and disease management strategies and reduce healthcare costs.[30] A multi-phase, explanatory sequential mixed methods design (qualitative to quantitative to qualitative) was used to gain a more comprehensive understanding of the implementation of the Prevention and Wellness Trust Fund interventions.[30]

The multi-phase, explanatory sequential mixed methods design used in this study enabled the researchers to provide a more holistic, comprehensive, and actionable evaluation of the PWTF intervention program. The findings from the study can help program developers and policymakers to identify the most effective strategies for addressing the target health issues and design programs that are sustainable and cost-effective.

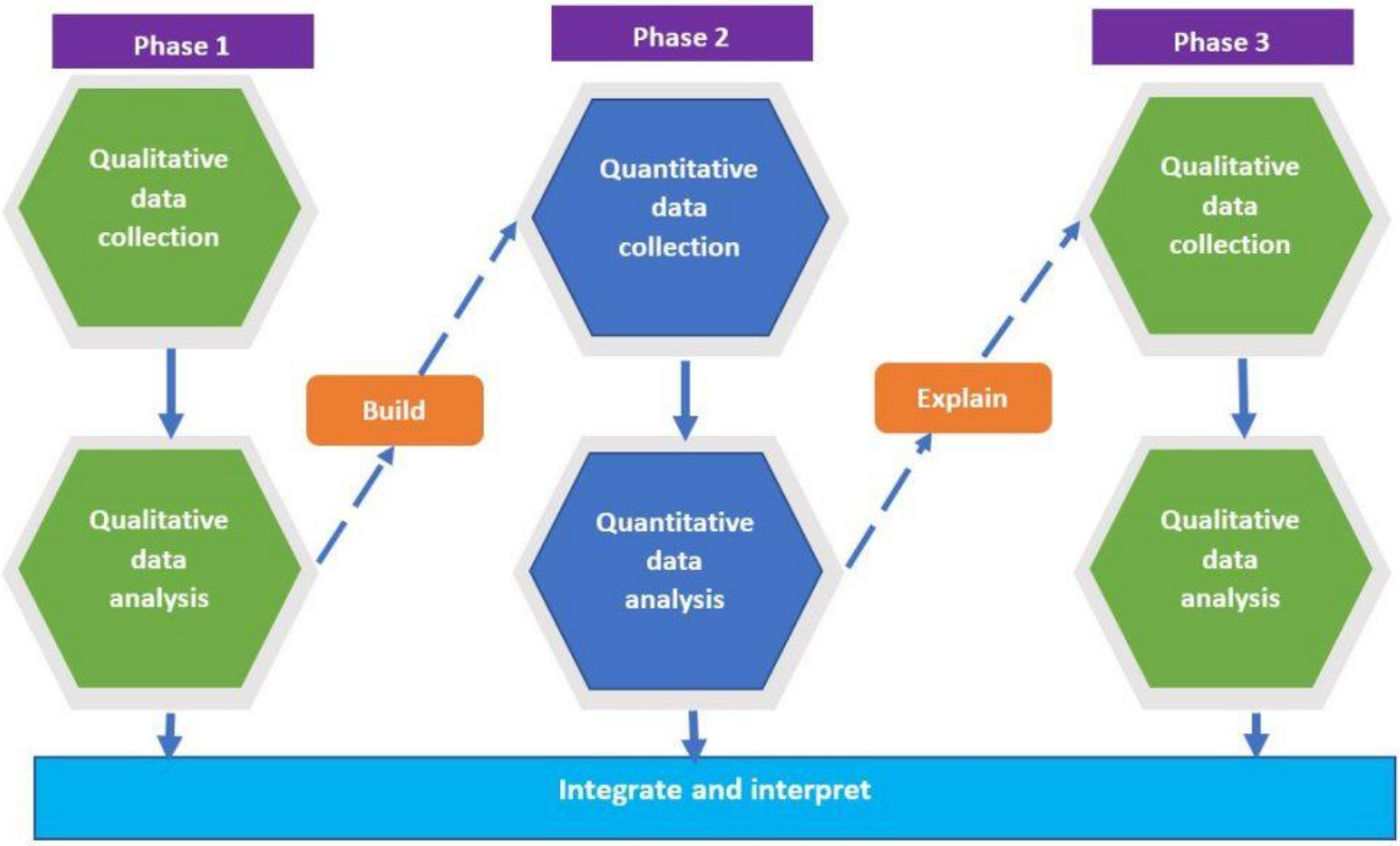

Figure 5.7 Multiphase mixed methods design by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

5.6 TRIANGULATION OF DATA

Triangulation in mixed methods research is also known as the integration of data. It refers to the process of using multiple methods, data sources, or perspectives to gain a more comprehensive understanding of a research problem.[31,32] Mixed methods research involves triangulating the same phenomenon using different data collection methods (e.g. surveys and interviews) or different data sources (e.g. self-reported data and observed data).[32] In mixed methods studies, researchers methodically integrate or blend quantitative and qualitative data to maximise the strengths and minimise the flaws of each technique.[32] Triangulation can be used to validate and reinforce the research results by providing multiple perspectives on the same phenomenon and identifying areas of discrepancies or complexities.[31,32] This can help identify and explain biases and increase the validity of the study findings.[31,32] For example, suppose a researcher wishes to study the impact of a new educational program on student performance. In that case, surveys may be used to collect quantitative data on student performance, and interviews may be used to obtain qualitative data on student perceptions of the program. The researcher can then triangulate the data by comparing and

contrasting survey data on student performance with interview data on student perceptions. This would help provide a more comprehensive understanding of the program's impact on student performance. Specific techniques for integrating qualitative and quantitative research procedures and data exist. Data integration could occur at the design, methods, interpretation and reporting levels.[33]

Integration at the Design Level

The basic and advanced mixed methods designs can be used to integrate at the design level or conceptualisation stage of the research. As stated above, the basic designs include convergent, exploratory sequential and explanatory sequential design. In sequential designs, the findings of one technique are used to build the other method or phase. In contrast, convergent designs aim to combine the phases so that the quantitative and qualitative results may be compared.[34]

Integration at the Methods level

Method level integration commonly relates to the type of design used in a study. Creswell and Plano Clark conceptualize integration to occur by linking data collection and analysis.[32] Linking occurs in several ways: (1) merging; (2) connecting; (3) building; and (4) embedding (Figure 5.7). In a single line of inquiry, integration may occur through one or more of these approaches.[32] For example, connecting follows naturally in sequential designs, while merging can occur in any design. Embedding generally occurs in an interventional design. Thus, the design sets parameters for what methodological integration choices can be made.

Merging: Integration through data merging occurs when researchers bring the two databases together for analysis and comparison. Merging of data typically occurs after the statistical analysis of the numerical data and qualitative analysis of the textual data. This type of integration consists of combining the qualitative and quantitative data by reporting results in a discussion section of study.[35] The reporting could start with the quantitative statistical results and subsequently incorporate the identified themes and qualitative quotes to support or refute the quantitative results. It also can be achieved by transforming the qualitative themes into quantifiable results (content analysis), which can be compared with the quantitative dataset.[36] Tables or figures that portray both the quantitative and the qualitative results can also be used to present the integration.[34]

Connecting: Integration through connecting occurs when one type of data connects with the other data via the sampling frame. Whether the design is sequential or convergent, connecting can occur through sampling.[34] For example, a study can include a survey and qualitative interviews and participants for the interviews are drawn from the population of survey respondents.[34] This integration

entails analysing one dataset, such as the quantitative survey, and then utilising the results to inform subsequent data gathering for the qualitative part (e.g., interview questions and identification of participants to interview).[34] By linking the analysis of the quantitative phase's results with the qualitative phase's data gathering, the integration is accomplished in this way.[34]

Building: Integration via building entails using results from one data collection procedure to guide another data collection strategy. Survey items can be developed using findings from qualitative data previously gathered that provide hypotheses or identify constructs or language used by study participants.[34] For example, Jafer et al., 2020 used themes from the qualitative interview to develop a quantitative survey tool that incorporated the three main themes from the qualitative study.[27]

Embedding: Integration through embedding occurs when data collection and analysis are linked at several points and is crucial in advanced interventional designs. The characteristic of embedding is repeatedly connecting qualitative data to quantitative data at multiple points. Embedding may occur during the pretrial phase, when qualitative (or a combination of qualitative and quantitative) data can be used in various ways, such as developing trial-specific measurement tools, clarifying outcome measures, and understanding contextual factors that may cause bias.[34] Qualitative data collection throughout the trial can be utilised to comprehend contextual aspects that may have an impact on the trial outcomes or offer in-depth details on the nature of the experience of the participants. In addition, post-trial qualitative data gathering can be used to establish hypotheses regarding adjustments that could be required for general adoption outside of a controlled research setting, explain outliers, or debrief subjects or researchers about events or experiences that occurred during the experiment.[34]

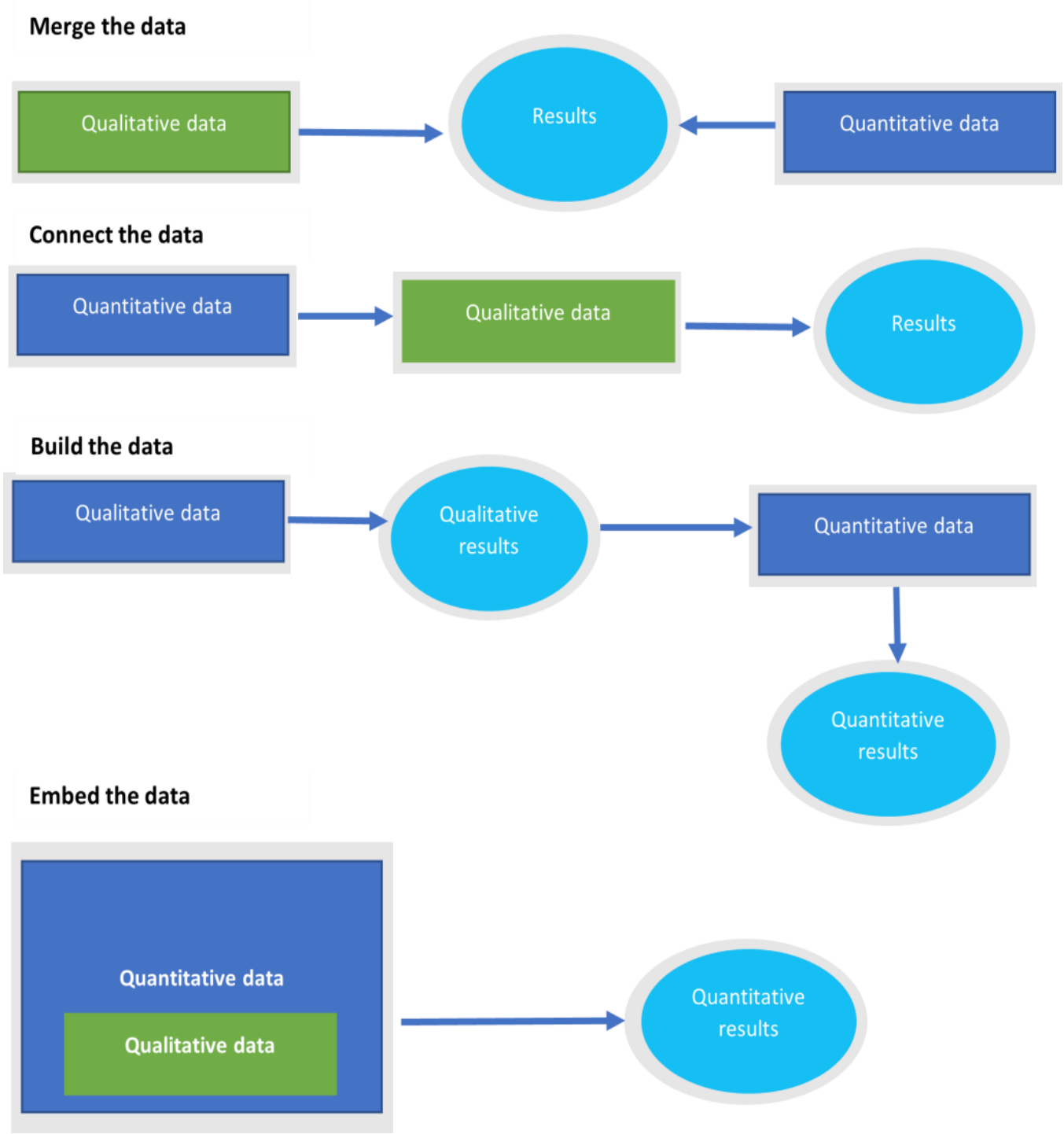

Figure 5.8 Integration techniques at methods level by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Integration at the Interpretation and Reporting Level

Three methods are used to integrate qualitative and quantitative data at the interpretation and reporting levels: (1) narrative integration; (2) data transformation integration; and (3) joint displays integration.[34]

Integration through narrative: Researchers use narratives to describe the quantitative and qualitative data findings. This approach allows for a more holistic understanding of the research question and can provide a more comprehensive view of the phenomenon being studied.[34] There are three techniques for narrative integration in research papers. In the contiguous approach, the results are presented in a single report using the contiguous method of integration, although the qualitative and quantitative findings are presented in various parts.[34] The weaving approach entails writing qualitative and quantitative results together theme by theme or concept by concept in one report or a series of reports. The staged approach to integration frequently occurs in multiphase mixed method research when each phase's conclusions are presented in stages as the data are evaluated and published independently.[34]

Integration through data transformation: Two phases are involved in integration through data transformation. One type of data must first be transformed into a different kind of data (i.e., qualitative into quantitative or quantitative into qualitative).[34] The modified data are combined with the raw data in the second step. In mixed methods, data transformation refers to using content analysis to convert qualitative data into numeric counts and variables so that the data may be merged with a quantitative database. Refer to Chapter 4 for details on content analysis.[34]

Joint display integration: To obtain fresh insights beyond those obtained from the individual quantitative and qualitative results, researchers may integrate their data by presenting both findings together using data visualisation techniques. Related data can be presented as a figure, table, matrix, or graph.[34] For example, a group of researchers sought to assess and explore the impact of four chronic diseases on patients' quality of life (QoL) using both quantitative and qualitative research methods. Patients' self-reported quality of life was obtained via a survey, while their perceptions of the impact of the diseases were sought via individual interviews. The joint display integration of both quantitative and qualitative findings is presented in Table 5.1 below. In the table, the first column displays the chronic health conditions under investigation, the second column displays patients' self-reported quality of life ratings on a scale of 1 to 10, and the third column displays qualitative data related to patients' experiences of chronic health conditions.

Table 5.1: An example of a joint display integration of both quantitative and qualitative findings

Health condition	Quality of Life Rating (Quantitative data)	Qualitative Data
Chronic pain	4/10	• "Living with chronic pain has really impacted my quality of life. It's hard to enjoy things I used to love and even simple tasks can be difficult.“ • "My back pain can be very difficult to manage and living with it is a daily struggle
Heart disease	6/10	• "I've had to make some lifestyle changes since my heart disease diagnosis, but overall, I feel like I have a decent quality of life." • "My heart disease can be a concern, but I'm managing it with medication and lifestyle changes like eating a heart-healthy diet and getting regular exercise. I also find comfort in spending time with my family."
Depression	2/10	• "My depression makes it hard for me to find joy in anything. It's really impacting my quality of life and I'm not sure what to do about it." • "My depression can make it hard to get out of bed in the morning, and I often feel hopeless and helpless.
Diabetes	8/10	• "Managing my diabetes can be challenging, but I'm grateful for the resources available to me. I feel like I have a good quality of life despite my condition." • "I've been able to manage my diabetes well through medication and lifestyle changes like regular exercise and healthy eating. I feel grateful for the support of my healthcare team and my family."

Rigour and trustworthiness

In mixed methods research, rigour and trustworthiness are crucial factors to take into account since they relate to the quality and credibility of the research study.[37] Rigour refers to the degree to which a study is conducted in a systematic, thorough, and accurate way. In comparison, trustworthiness is the degree to which the findings of a study can be trusted to be credible, authentic, and dependable. Ensuring rigour in mixed methods research involves paying attention to the design of the study, the sampling plan, the data collection methods, and the data analysis methods.[38] On the other hand, trustworthiness is established by assessing the transparency of the research process, the credibility of the data and the conclusions, and the dependability and confirmability of the findings.[37] However, establishing rigour and trustworthiness in mixed methods research is challenging due to the discrepancies between evaluating quantitative and qualitative procedures. In quantitative research, the study needs to be internally valid and reliable to be generalizable. On the other hand, credibility, transferability, dependability, and confirmability characteristics are regarded as the “gold standard” in qualitative research. Researchers must increase the reporting of quantitative and qualitative data rigour to assess the quality of mixed methods studies and their outcomes.[38] Further details on these concepts are provided in chapters 3 and 4.

An example of how rigour can be achieved is presented in the sequential explanatory mixed methods study conducted by Albert et al. [28] To ensure rigour and trustworthiness, the authors used several strategies. For the survey, they conducted a pilot study to test the survey questions and ensure their validity and reliability. They also used a convenience sampling method and provided information sheets with clear instructions about the research to the participants. For the interviews, the authors purposively selected a heterogeneous mix of participants based on their survey responses. Furthermore, the authors used multiple sources of data (interviews and survey responses) to triangulate the research findings, and they conducted member checking to ensure the accuracy of the data.

5.7 CONCLUSION

To wrap up, let's return to Stephanie and Joane's story about deciding to order both Sukiyaki and Tonkatsu and share their meals to savour the 'best of both worlds'. This story can serve as a helpful analogy for understanding the benefits and challenges of mixed-methods research.

First, just as Stephanie and Joane wanted to experience and enjoy the benefits of both dishes, mixed methods research combines quantitative and qualitative research methods to take advantage of the strengths of both approaches. Quantitative research focuses on collecting and analyzing numerical data, while qualitative research is concerned with exploring and understanding the meaning behind human experiences and behaviours. By combining these two methods, mixed methods research can provide a more comprehensive and nuanced understanding of a research question or phenomenon.

Second, sharing the meals allowed Stephanie and Joane to try multiple dishes without having to commit to just one. Similarly, mixed methods research allows researchers to explore a research question from multiple angles and with multiple data sources. This can help to ensure that the findings are robust and more fully capture the complexity of the phenomenon under study.

Finally, Stephanie and Joane would have needed to be mindful of portion sizes and ensure that everyone got a fair share. In the same vein, mixed methods researchers must carefully balance the use of quantitative and qualitative data in a way that is appropriate for the research question and goals. This requires thoughtful planning and design of the research study, as well as careful analysis and interpretation of the results.

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6. CHOOSING THE RIGHT STUDY DESIGN

"Look for your choices, pick the best one, and then go with it" – Pat Riley

In this chapter you will learn about:

- choosing the right study design
- ethical considerations
- writing a research proposal.

Opening Scenario

As stated by Pat Riley, a former player and coach in the American National Basketball Association (NBA), in life, you need to "**Look for your choices, pick the best one, then go with it**". This is true for research too! Research turns out to be successful if a suitable research design has been incorporated. However, selecting an appropriate research design can be challenging especially when there are many options to choose from. As they say, when you only have one option, it's simply an option. Two options make a dilemma. Three options present a real choice. It could be a simple decision such as "should I order a sponge cake or roasted strawberry crumble for dessert?" to a more complex decision with much higher stakes like where to live. For example, as a student who is studying away from home, Paul needed to find accommodation and he wanted a place that was convenient in terms of been in close proximity to the campus as well as the shopping mall. Paul went for some house inspections and found two places that met his requirements. However, he decided to settle for the second-best choice because the rental price for his first preference was above his budget. This kind of dilemma can happen when choosing a research design. High funding cost could mean that one is unable to do an RCT. In Paul's case, he needed to choose only one place of abode that he could afford. Sometimes, we don't have to choose only one option. Remember, the story about Stephanie in Chapter 5, who had the opportunity to partake in the best of both worlds with her two favourite dishes – Sukiyaki and Tonkatsu. As discussed in Chapter 5, mixed methods design gives researchers the privilege of saying "yes" to both quantitative and qualitative study designs and it works out well. However, like Paul, researchers need to make some considerations to be able to choose the most suitable study design for their research. Let's now delve into the things that need to be considered.

6.1 SELECTING THE APPROPRIATE STUDY DESIGN

One of the most fundamental issues in determining how to conduct a study is determining the right study design to answer a research question and to achieve the stated aims of a research idea. It is essential to select the appropriate study design as it is crucial in determining the methodology of any research. There are different study designs under three broad categories, namely quantitative, qualitative and mixed methods research, and these have been discussed in chapters 1, 3, 4 and 5. Quantitative research measures quantifiable things while seeking to investigate the relationship between variables and utilises numerical data and statistical analysis to understand the phenomenon.[1] On the other hand, qualitative research aims to explore and develop an in-depth understanding of the concept with an emphasis on the development process.[2] The mixed method combines quantitative and/ or qualitative methods with features of both methods integrated into mixed method research.[3] The question is, how can a researcher decide on a study design type given the numerous options? The choice depends on the following key factors- the research question, resources (timing and funding), data availability and study population, ethical considerations and research expertise. This video clip gives a quick recap of the different research methods and study designs that we presented in chapters 3, 4 and 5.

6.2 THINGS TO CONSIDER WHEN CHOOSING YOUR STUDY DESIGN

The animation below highlights the things to consider when choosing a research design.

Choosing the right study design video by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC ND 4.0 licence

The Research Question

In making a decision about the right study design, the first point of consideration is the research question. The aim of the study and the type of research question being asked influences the type of study design that is most appropriate and ultimately determines the choice.[4] For example, if the goal is to profer a new treatment option, a quantitative study such as a randomised controlled trial would be the best option. In contrast, prospective cohort research should be conducted if the question is about "prognosis/natural history/exploration of risk factors.[4] On the other hand, if the study is related to harmful events, you will likely use a case-control study. Questions that seek to explore people's

perceptions and experiences will require qualitative inquiry, while questions that seek to provide comprehensive and multiple perspectives can utilise mixed-method design.[4]

Resources

Another major factor to consider is the availability of resources, which include project time and funding, as these can limit one's options for study design.[5] Available timeframe for the execution of a research project would determine participant recruitment and data collection options. For example, you may be interested in conducting a prospective cohort study among women to observe the incidence of breast cancer and potential risk factors such as family history and hormone use. As you know, prospective cohort studies require following up with participants over a time period to obtain the outcome, and in the case of breast cancer, this can take several years. However, suppose you have only six months to conduct your research project due to the time constraint. In that case, you may consider conducting a retrospective cohort study instead, which allows you to utilise existing health records. In addition, costs associated with research designs vary. Randomised controlled trials (RCTs) can be very expensive compared to other study designs. Furthermore, studies requiring only a short duration (such as some studies on infectious diseases) are less expensive than studies of chronic illnesses, which may require long-term observation of subjects for years.[5]

Data availability and study population

Data availability and easy access to/ recruitment of study participants can influence the choice of research design and research topic/question in different ways. For example, enrolling participants in observational studies is typically simpler than enrolling them on intervention trials. Observation studies require less participation time; therefore, prospective participants are more inclined to be interested in participating. In addition, the characteristics of the study population, such as age, type of illness, or location, can also determine the choice of study design.[5] For example, if the study utilises online survey for data collection and is targeted at the older population, only some of whom are active online. It wouldn't be appropriate to use an online survey as a data collection tool, because this may bias recruitment of participants. Instead, it would be better to conduct interviews or focus groups with the participants.

Ethical considerations

It is also important to assess possible ethical concerns when making study design choices. Based on the research goals and questions, some types of study designs may raise ethical concerns or may not be feasible to conduct ethically.[5] Studies that exploit vulnerable populations or involve exposing

people to hazardous materials or processes without adequate protection are unethical. For example, RCTs, which are considered the gold standard in quantitative research and evidence-based medicine, may not be feasible in some cases, and other study designs, like observational studies, may be more appropriate. To emphasise the point about the inappropriateness of using RCTs in some cases, two researchers (Gordon and Pell)[6] published findings of their systematic review of randomised controlled trials that examined parachute use to prevent death and major trauma related to gravitational challenge. Unsurprisingly, these researchers stated that they could not find any RCT on the research topic. This is because it is unethical and harmful to randomise participants into a group with a parachute and another group without a parachute to assess the effectiveness of parachutes.[6]

Let's explore the concept of ethical considerations further because it is a very important aspect of research. Without ethics clearance, it is usually impossible to conduct research.

6.3 PRINCIPLES OF RESEARCH ETHICS

There are general ethical principles that guide and underpin the proper conduct of research. The term "ethical principles" refers to those general rules that operate as a foundational rationale for the numerous specific ethical guidelines and assessments of human behaviour.[7] The National Statement on 'ethical conduct in human research' states that ethical behaviour entails acting with integrity, motivated by a deep respect and concern for others.[8] Before research can be conducted, it is essential for researchers to develop and submit to a relevant human research ethics committee a research proposal that meets the National Statement's requirements and is ethically acceptable. There are five key ethical research principles – respect for autonomy, beneficence, non-maleficence, and justice[8,9] (Figure 6.1). These principles are universal, which means they apply everywhere in the world, without national, cultural, legal, or economic boundaries. Therefore, everyone involved in human research studies should understand and follow these principles.

Figure 6.1 Ethical principles by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Research merit and integrity

Research merit and integrity relate to the quality or value of a study in contributing to the knowledge base of a particular field or discipline. [8,9] This is determined by the originality and significance of the research question, the soundness and appropriateness of the research methodology, the rigor and reliability of the data analysis, the clarity and coherence of the research findings, and the potential impact of the research on advancing knowledge or solving practical problems. Research must be developed with methods that are appropriate to the study's objectives, based on a thorough analysis of the relevant literature, and conducted using facilities and resources that are appropriate for the study's needs. In essence, research must adhere to recognised standards of integrity and be designed, reviewed and conducted in a manner that ensures quality and transparency.[8] Examples of unacceptable practices include plagiarism through appropriation or use of the ideas or intellectual property of others; falsification by creating false data or other aspects of research (including documentation and consent of participants); distortion through improper manipulation and/or selection of data, images and/or consent.

Respect for persons

Respect for humans is an acknowledgement of their inherent worth, and it refers to the moral imperative to regard the autonomy of others.[8,10] Respect entails taking into account the well-being, beliefs, perspectives, practises, and cultural heritage of persons participating in research, individually and collectively. It involves respecting the participants' privacy, confidentiality, and cultural sensitivity.[8] Respect also entails giving adequate consideration to people to make their judgements throughout the study process. In cases where the participants have limited capacity to make autonomous decisions, respect for them entails protecting them against harm.[8] This means that all participants in research must participate voluntarily without coercion or undue influence, and their rights, dignity and autonomy should be respected and adequately protected.

Beneficence

The ethical principle that requires actions that promote the well-being and interests of others is known as beneficence.[10] It is the fundamental premise underlying all medical health care and research.[8] Beneficence requires the researcher to weigh the prospective benefits and hazards and make certain that projects have the potential for net benefit over harm.[8,10] Researchers are responsible for: (a) structuring the study to minimise the risks of injury or discomfort to participants; (b) explaining the possible benefits and dangers of the research to participants; and (c) the welfare of the participants in the research setting 8. Thus, the study participants must always be prioritised over the research methodology, even if this means invalidating data.[8]

Non-maleficence

This is the ethical principle that requires actions that avoid or minimize harm to others. According to the principle of non-maleficence, participating in a study shouldn't do any harm to the research subject. This principle is closely related to beneficence; however, it may be difficult to keep track of any damage to study participants.[11] Different types of harm could occur, including physical, mental, social, or financial harm. While the physical injury may be quickly recognised and then avoided or reduced, less evident issues such as emotional, social, and economic factors might hurt the subject without the researcher being aware.[11] It is essential to note that all research involve cost to participants even if just their time, and each research study has the potential to hurt participants, hence it is important to ensure that the merit of research outweighs the costs and risks. There are five

categories into which studies may be categorised based on the possible amount of injury or discomfort that they may expose the participants to.[11]

- No anticipated effects
- Temporary discomfort
- Unusual levels of temporary discomfort
- Risk of permanent damage
- Certainty of permanent damage

Justice

The concept of fairness and the application of moral principles to ensure equitable treatment. According to this research tenet, the researcher must treat participants fairly and always prioritise the needs of the research subjects over the study's aim.[8,11] Research participants must be fairly chosen, and that exclusion and inclusion criteria must be accurately stated in the research's findings.[8] In addition, there is no unjust hardship associated with participating in research on certain groups, and the participant recruitment method is fair. Furthermore, the rewards for research involvement are fairly distributed; research participants are not exploited, and research rewards are accessible to everybody equally.[8]

6.4 A CASE STUDY – THE TUSKEGEE SYPHILIS EXPERIMENT

There are different examples in the literature of unethical research that have been conducted in the past. Let's review one of the studies**.**

One of the most famous pieces of unethical research undertaken in the United States was the Tuskegee Syphilis study. Officially known as the Tuskegee Syphilis Study – An American medical research study called Study of Untreated Syphilis gained attention for its unethical testing on African American patients in the rural South.[12] The U.S. Public Health Service (PHS) experiment, which ran from 1932 through 1972, looked at the untreated syphilis natural course among African American men.[12] The study aimed to find out if the natural course of syphilis in black males differed considerably from that in whites and to see if cardiovascular damage was more common from syphilis than neurological impairment. The participants were not informed that they had syphilis or that sexual activity may spread the illness. Instead, they were informed that they had "bad blood," a phrase used locally to describe a variety of ailments. Informed consent was not collected from the participants.[12] Some patients received arsenic, bismuth, and mercury as part of the study's initial

treatment phase. However, when the initial research could not yield any valuable information, it was decided to keep track of the participants until they passed away and stop all therapy.[12] After penicillin became available in the middle of the 1940s, the sick men were refused medication; this was still the case 25 years later, in clear contravention of government regulations that required the treatment of venereal disease. More than 100 of the subjects are thought to have passed away from tertiary syphilis.[12]

Watch the YouTube video below which briefly describes this study.

Let's now consider this research in relation to the key principles of research ethics.

Research merit and integrity: The Tuskegee Syphilis Experiment violated the principle of merit and integrity because it lacked scientific merit. The study was based on outdated and flawed scientific assumptions and failed to contribute to the advancement of scientific knowledge. The study also lacked integrity because the researchers did not adhere to scientific standards of ethical conduct, including obtaining informed consent from the participants.

Respect: The experiment also violated the principle of respect for persons because the researchers did not respect the autonomy of the study participants. The participants were not informed of the nature of the experiment, and they were not given the option to refuse participation. The researchers also failed to respect the dignity and worth of the participants by denying them proper medical treatment.

Beneficence: The experiment violated the principle of beneficence because the researchers failed to maximize benefits and minimize harms to the participants. The participants were denied effective medical treatment, which caused them to suffer needless pain and suffering. The researchers also failed to provide the participants with adequate medical care, even when it became clear that they had contracted syphilis.

Non-maleficence: The men were subjected to invasive, painful procedures, including spinal taps. The men were not informed about their disease, leaving their spouses and other family members vulnerable to catching the disease from them. The study violated the principle of non-maleficence because the researchers did not take steps to avoid causing harm to the participants. The researchers knowingly withheld effective medical treatment from the participants, which caused them to suffer from severe health complications, including blindness, paralysis, and death.

Justice: The study violated the principle of justice because it treated the participants unfairly. The study was conducted exclusively on African American men from a state in the south of the United States, who represented a very vulnerable population and they were denied proper medical treatment.

The study also failed to provide compensation or medical care to the participants after the experiment ended.

Overall, the Tuskegee Syphilis Experiment is a significant violation of research ethics. The experiment lacked scientific merit, failed to respect the autonomy of the participants, caused needless harm, violated the principle of non-maleficence, and treated the participants unfairly. The experiment highlights the need for ethical guidelines in research to protect the rights and welfare of research participants.

In Australia, the National Statement on Ethical Conduct in Human Research was enacted to ensure the ethical conduct of human research. The National Statement was developed jointly by the National Health and Medical Research Council, the Australian Research Council and Universities Australia. Researchers must adhere to the National Statement on Ethical Conduct in Human Research, which provides guidelines for ethical research practices. This includes ensuring that the research is culturally sensitive, respectful, and acknowledges the rights of Indigenous participants. The National Statement provides guidelines for researchers, Human Research Ethics Committees (HRECs) and others conducting an ethical review of research. It also emphasises institutions' responsibilities for the quality, safety and ethical acceptability of research that they sponsor or permit to be carried out under their auspices.[8]

The National Statement is intended for use by:

- any researcher conducting research with human participants;
- any member of an ethical review body reviewing that research;
- those involved in research governance; and
- potential research participants

Before conducting a study, researchers must obtain ethics clearance from all relevant ethics governance bodies, including university bodies and medical institutions. When conducting human research, it is important to abide by the following requirements:

- An individual's decision to participate in research must be voluntary and based on a well-informed and reasonable understanding of both the proposed research and the implications of participating in it.
- Voluntary and informed participation requires a proper understanding of research objectives, methods, requirements, risks and potential benefits.
- This information should be presented in a manner appropriate to each participant.

- The process of providing information to participants and obtaining their consent should not be just a matter of meeting formal requirements. Participants can ask questions and discuss information and decisions as needed.
- Consent can be expressed orally, in writing, or by other means (eg, survey or action reply implying implied consent).
- It is generally reasonable to reimburse participants for research participation costs such as travel, lodging, and parking. Participants may also be paid for their time. However, payments disproportionate to the time involved or other incentives designed to encourage participants to take risks are ethically unacceptable.

Now identify the ethical issues that may arise in the case scenario presented in the Padlet below

6.5 WRITING A RESEARCH PROPOSAL

Before conducting a study, researchers need to develop a research proposal that provides an overview of a research project to help others (such as ethics committee, prospective participants, funding bodies) understand the scope of the research, the importance of the research, the proposed methodology and the chosen research methods. A well-thought-out proposal is a foundation or blueprint for a proposed investigation, making it a crucial stage of the research process. However, for many students writing a research proposal can be a challenging effort.[13-15] As a novice researcher, before writing your research proposal, you should ensure that you speak extensively with methodologists, experienced researchers, ethics advisors, and statisticians early in the process. Make sure the study is practical, that there are enough acceptable and accessible patients, and that you have the required resources (particularly time, budget and expertise).[4]

An outline of what is required in a proposal is provided below:

1. The front matter
   - The title of the proposal.
   - The names and affiliations (institutions) of the principal investigator (lead researcher) and the co-investigators.
   - The email addresses and phone numbers of the investigators

2. The main content

- Abstract
- Introduction
- Literature review
- Aims and objectives
- Methodology
- Data management and analysis
- Ethical consideration
- Timelines
- Budget
- References
- Appendices

6.6 CONCLUSION

This chapter accentuates the importance of choosing the right study design. Selecting an appropriate research design is crucial for the success of any research project. Just like making choices in everyday life, researchers are faced with the challenge of selecting the best research design from a range of options available. Factors such as high funding costs, time constraints, and ethical considerations can influence the choice of research design.

For example, just like Paul had to settle for his second-best accommodation option due to budget constraints, researchers may have to choose a research design that is within their financial means. For instance, if the research question is focused on causal relationships, a randomized controlled trial (RCT) may be the most appropriate design. However, an RCT can be resource-intensive, and the cost may not be feasible. In such cases, researchers may need to consider other designs, such as quasi-experimental designs or observational studies. In some cases, mixed methods design may be the most suitable option, just as Stephanie could enjoy both Sukiyaki and Tonkatsu dishes.

When selecting a research design, researchers must also consider ethical principles to ensure that their study is conducted in an ethical manner. This includes ensuring that informed consent is obtained from study participants, protecting the privacy and confidentiality of participants, and minimizing any potential harm or risks to participants.

In summary, choosing the right research study design requires careful consideration of various factors, including funding, time, and ethical principles. By carefully evaluating the options available and selecting the most appropriate design, researchers can increase the chances of conducting a successful study.

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JUDGING THE EVIDENCE

"It is wrong always, everywhere, and for anyone to believe anything on insufficient evidence" – William Kingdon Clifford

In this chapter you will learn how to:

- interpret and quality-assure research evidence
- develop the different components of a research paper
- critically appraise the quality of published articles using a logical framework.

Opening Scenario

One real-life scenario that demonstrates this quote by William Kingdon Clifford is the thalidomide tragedy of the 1950s and 1960s. Thalidomide was a medication prescribed to pregnant women in order to alleviate morning sickness. However, it was later discovered that the drug caused severe birth defects in newborns. Thousands of babies were born with missing or deformed limbs, and many died shortly after birth.

The tragedy occurred because the drug was not properly tested before it was released to the market. The manufacturer relied on anecdotal evidence and positive testimonials from doctors and patients, rather than conducting rigorous scientific studies. As a result, thalidomide was widely prescribed to pregnant women without sufficient evidence to support its safety.

The thalidomide tragedy serves as a powerful reminder of the importance of evidence-based decision-making in all areas of life, particularly when it comes to public health and safety. It shows that it is wrong always, everywhere, and for anyone to believe anything on insufficient evidence, and that rigorous scientific testing and evaluation is essential to ensure the safety and well-being of individuals and society as a whole.

7.1 READING RESEARCH PAPERS

As health professionals, you may find yourself referring to research articles to make clinical decisions based on the best available research evidence. However, knowing how to read and critically appraise a scientific paper is important before accepting the reported findings or applying them to a new context. Generally, as health professionals, you are most unlikely to accept what has been written in magazines, blogs, or news reports as scientific evidence, irrespective of the promising outcomes. Rather, you will search the literature for articles published in scholarly journals, as many of us believe that the findings reported are valid and reliable given that they have gone through peer review process. However, this is not always true or even when it is the case, the evidence may be insufficient to answer the question that the reader has. Evidence shows that studies may include defects or biases that go undiscovered, such as wrong study design choices, insufficient sample size, erroneous results, lack of originality, and poor writing styles. For example, there are currently 289 retracted COVID-19 papers that have been withdrawn for various reasons, highlighting the need for careful adoption of findings published in journals.[1] Furthermore, there are many health-related journals that charge authors payment to publish their work but provide little or no peer review or editorial oversight, resulting in low-quality, unreliable research.[2] These are referred to as predatory journals. These journals frequently imitate reputable journals and are aimed towards early-career scholars or those who are unfamiliar with the publishing landscape.[2]

When evaluating the appropriateness of research to a particular context of interest, there are several important factors to consider, including:

- Transferability: This refers to the degree to which the findings of a study can be transferred or generalized to other contexts beyond the original study. To evaluate transferability, consider whether the study sample and setting are similar to the context of interest, and whether the study findings are likely to apply in the same way to the new context.

- External Validity: This refers to the degree to which the findings of a study can be generalised to other populations beyond the original study sample. To evaluate external validity, consider whether the study sample is representative of the population of interest, and whether the study findings are likely to apply in the same way to other populations.
- Internal Validity: This refers to the degree to which a study's design, methodology, and analysis allow for a causal inference between the independent and dependent variables. To evaluate internal validity, consider whether the study design was appropriate to answer the research question, whether the study controlled for other factors that could influence the results, and whether the statistical analysis was appropriate.
- Relevance: This refers to the degree to which the study's research question and findings are directly applicable to the context of interest. To evaluate relevance, consider whether the study's research question aligns with the research question in the context of interest, and whether the study's findings are directly relevant to the problem being addressed.
- Timeliness: This refers to the degree to which the study's findings are current and relevant to the context of interest. To evaluate timeliness, consider whether the study was conducted recently enough to provide up-to-date information, and whether the findings are still relevant to the current context.
- Ethics: This refers to the degree to which the study was conducted in an ethical and responsible manner, with appropriate consideration for the welfare of study participants and respect for their rights and dignity.
- It is imperative to do a proper quality check (known as critical appraisal) of research articles to ascertain the value of the scientific evidence that they present. However, before embarking on discussing the critical appraisal procedure, it is important to understand the structure or parts of a scientific article and to know what each section should contain. Thus when reading a paper, the knowledge of what is expected in each section will guide you in the review and appraisal process.

7.2 STRUCTURE OF A PAPER

While the format for scientific articles varies by journal type, the general components include an abstract, introduction, methods, results, discussion and references. These components are presented in Table 7.1 and discussed below.

Table 7.1: Components of a research paper

Sections of paper	Process
Abstract	What did the authors do in a nutshell?
Introduction	What is the problem?
Methods (and materials)	How did the authors solve the problem?
Results	What did the authors find out?
Discussion	What does it mean?
Conclusion	What is the key significance?
Acknowledgements (optional)	Who helped the authors out?
References	Whose work did the authors refer to?
Appendices	Extra information

Abstract: This is a brief summary of the paper which outlines the aim, methods used, results obtained, and conclusion. It should be concise, highlighting the research's purpose and major results. The abstract is essential as it gives the reader a quick overview of the paper's content, provides an opportunity to catch the reader's attention and assists the reader in deciding whether they want to read the full article in-depth. Figure 7.1 indicates the things to consider when writing an abstract. There are different journal specifications of the abstract format, which could be structured – using sub-headings or unstructured 3 (see Figures 7.2 and 7.3).

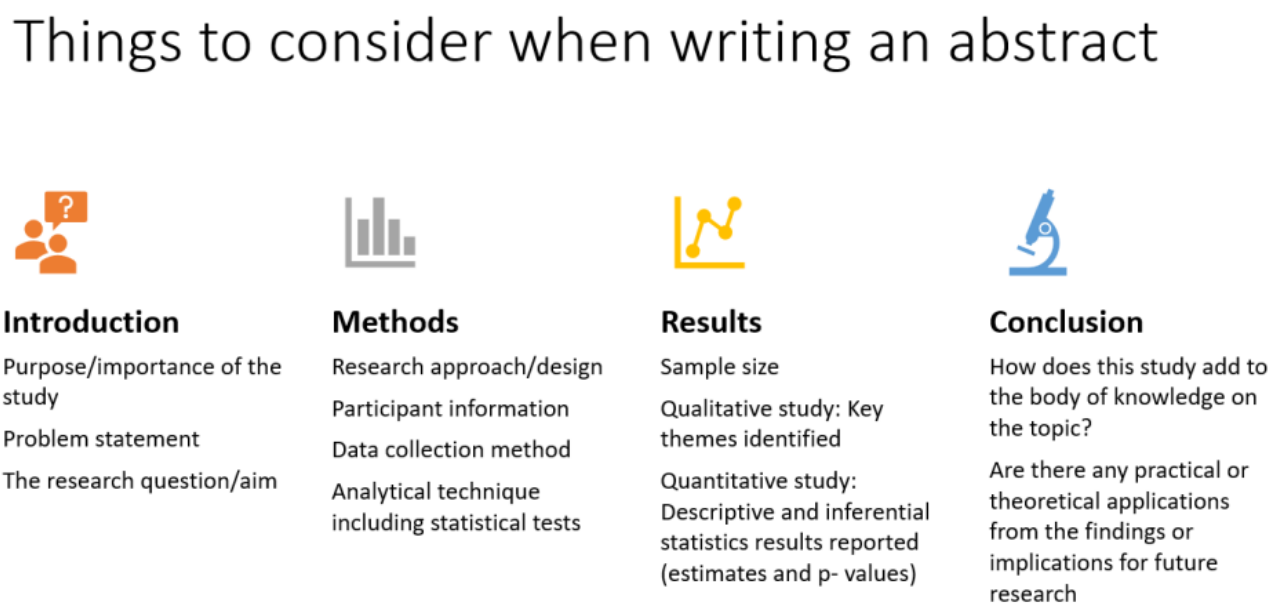
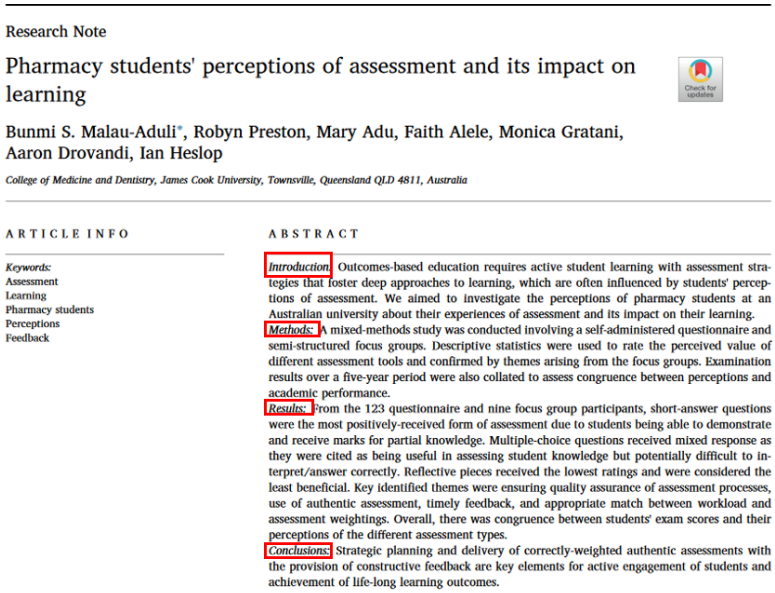


Figure 7.1 Things to consider when writing an abstract by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence



Research Note

Pharmacy students' perceptions of assessment and its impact on learning

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ABSTRACT

Introduction: Outcomes-based education requires active student learning with assessment strategies that foster deep approaches to learning, which are often influenced by students' perceptions of assessment. We aimed to investigate the perceptions of pharmacy students at an Australian university about their experiences of assessment and its impact on their learning.

Methods: A mixed-methods study was conducted involving a self-administered questionnaire and semi-structured focus groups. Descriptive statistics were used to rate the perceived value of different assessment tools and confirmed by themes arising from the focus groups. Examination results over a five-year period were also collated to assess congruence between perceptions and academic performance.

Results: From the 123 questionnaire and nine focus group participants, short-answer questions were the most positively-received form of assessment due to students being able to demonstrate and receive marks for partial knowledge. Multiple-choice questions received mixed response as they were cited as being useful in assessing student knowledge but potentially difficult to interpret/answer correctly. Reflective pieces received the lowest ratings and were considered the least beneficial. Key identified themes were ensuring quality assurance of assessment processes, use of authentic assessment, timely feedback, and appropriate match between workload and assessment weightings. Overall, there was congruence between students' exam scores and their perceptions of the different assessment types.

Conclusions: Strategic planning and delivery of correctly-weighted authentic assessments with the provision of constructive feedback are key elements for active engagement of students and achievement of life-long learning outcomes.

- Defined sections
- Full coverage of the paper
- Easy for readers to understand

Figure 7.2 A structured abstract by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

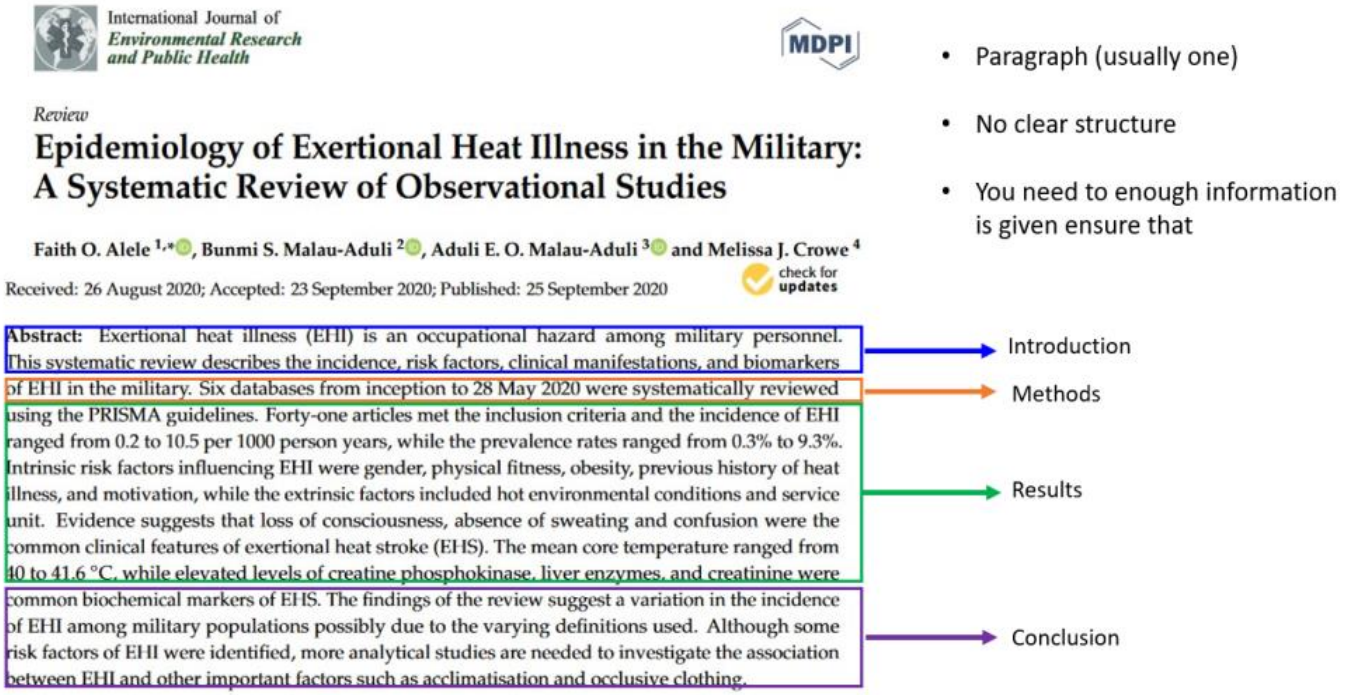

Figure 7.3 An unstructured abstract by Bunmi Malau-Aduli and Faith Alele, used under a CC BY NC 4.0 licence

Introduction: this is the beginning that establishes the tone for the rest of the paper by providing pertinent background information and stating the issue that needs to be discussed in great detail.[4] Consider the introduction as the top of a funnel that starts wide to put the research into a context that someone unfamiliar with the research field might understand.[4] In addition, the introduction should provide information about why the study described in the paper has been undertaken.[3] Relevant gaps in the literature are identified and clearly stated, and the research questions, objective and hypothesis are stated at the end of the introduction.

Methods: The methods section follows the introduction and it should provide details and a complete description of the following.[5] Study design – the study design should be clearly stated

- Study population – A description of the population from which the sample was drawn should be provided. All inclusion and exclusion criteria should also be stated.
- Sampling method – The sampling procedure and sample size should be stated

- Data collection- How data was obtained and the tools used to assess the outcome measures should be provided
- Data analysis: Details of how the data was analysed should be stated. Where quantitative data was collected, the statistical test and the statistical software package used should be stated. In qualitative research, the data analysis approach used should be clearly stated.
- Ethics: Ethical approval statement with the details of the ethics review committee, the date of approval and the approval number should be documented. Please note that some journals may include details about ethics at the end of the article after the reference list).

The methods must be written in enough detail so that another researcher can repeat the study and readers can determine the relevance of the study to their own context/questions. Presentation of the results comes after the methods.

Results: The results section should present the findings of the study in an organised and objective manner laying the groundwork for the Discussion section where those data are interpreted subjectively.[4,5] The results section should include the first part, which entails the total number of participants and a description of the basic characteristics of the participants, including age and gender, followed by other sociodemographic characteristics like level of education.[4,5] The main results are stated after the description, and this presentation follows the specific research aims at the end of the introduction. It should be indicated in this part where there are missing data points. This section should include tables, figures, graphs and appropriate summaries for these data visualisation tools and referenced in the summaries.[4,5] An interpretation of the findings is written in the next section, which is the discussion.

Discussion: The discussion section should interpret the results, relate them to the background and objectives of the study, and draw conclusions.[4,5] The opening paragraph summarises the study's findings and emphasises their novelty and significance. A comparison of these findings to published literature results follows the opening paragraph.[4,5] A discussion with a structure that follows the same sequence as the objectives indicated in the introduction and the primary result in the result section makes reading easier. The discussion should also discuss the strengths and limitations of the study and suggest areas for future research and implications for policy and practice.[4,5] Following the discussion is the conclusion.

Conclusion: The conclusion is usually found as a separate section after the discussion. It is the final section of the research paper where the main findings are summarized, and the implications for future research are discussed. Some journal styles may require the conclusion as the last paragraph of the

discussion. The conclusions should convey the findings' relevance.[3,4] The conclusion should summarise the results of the study in a way that includes fresh insights or poses fascinating issues that developed as a consequence of the research rather than just restating the key findings.[3,4]

References: The list of references is placed after the conclusion, and this section lists all sources of information cited in the paper. It usually follows a specific citation style (such as APA, MLA, AMA, Vancouver, Havard, or Chicago).[5] The references should be organised according to the referencing style format prescribed by the journal and should be up to date. The use of appropriate references adds credibility to the study and strengthens the arguments made in the discussion.[5]

Activity 7.1: In this section, we would want you to engage with the interactive book, in which we have analysed the different components (parts) of a paper.

7.3 CRITICALLY APPRAISING THE LITERATURE

Now that you know the parts of a paper, we will discuss how to critically appraise a paper. Critical appraisal refers to the process of carefully and methodically reviewing research to determine its credibility, usefulness, and applicability in a certain context.[6] It is an essential element of evidence-based practice. As stated earlier, you want to ensure that what you read in the literature is trustworthy before considering applying the findings in practice. The key things to consider include the study's results, if the results match the conclusion (validity) and if the findings will help you in practice (applicability). A stepwise approach to reading and analysing the paper is a good way to highlight important points in the paper. While there are numerous checklists for critical appraisal, we have provided a simple guide for critical appraisal of quantitative and qualitative studies. The guides were adapted from Epidemiology by Petra Buttner (2015) and How to Read a Paper [*the basics of evidence-based medicine and healthcare (2019);* papers that go beyond numbers- qualitative research (1997)] by Trisha Greenhalgh to aid your review of the papers.[5,7,8]

A guide to reading scientific articles – Quantitative studies

What is the title of the study?

- Does the title clearly describe the study focus?
- Does it contain details about the population and the study design?

What was the purpose of the study (why was it performed)?

- Identify the research question
- Identify the exposure and outcome

What was the study design?

- Was the design appropriate for the study?

Describe the study population (sample).

- What was the sample size?
- How were participants recruited?
- Where did the research take place?
- Who was included, and who was excluded?
- Are there any potential sources of bias related to the choice of the sample?

What were data collection methods used?

- How were the exposure and outcome variables were measured
- How was data collected- instruments or equipment? Were the tools appropriate?
- Is there evidence of random selection as opposed to systematic or self-selection?
- How was bias minimised or avoided?

For experimental studies

- How were subjects assigned to treatment or intervention: randomly or by some other method?
- What control groups were included (placebo, untreated controls, both or neither)
- How were the treatments compared?
- Were there dropouts or loss to follow-up?
- Were the outcomes or effects measured objectively?

For observational studies

- Was the data collection process adequate (including questionnaire design and pre-testing)?
- What techniques were used to handle non-response and/or incomplete data?
- If a cohort study, was the follow-up rate sufficiently high?
- If a case-control study, are the controls appropriate and adequately matched?

How was the data analysed?

- Is the statistical analysis appropriate, and is it presented in sufficient detail?

What are the findings?

- What are the main findings of the study? Pay specific attention to the presented text and tables in relation to the study's main findings .
- Are the numbers consistent? Is the entire sample accounted for?

Experimental study

- Do the authors find a difference between the treatment and control groups?

- Are the results statistically significant? If there is a statistically significant difference, is it enough of a difference to be clinically significant?

Observational study

- Did the authors find a difference between exposed and control groups or cases and controls?
- Is there a statistically significant difference between groups?
- Could the results be of public health significance, even though the difference is not statistically significant? (This may highlight the need for a larger study).
- Are the results likely to be affected by confounding? Why or why not?
- What (if any) variables are identified as potential confounders in the study?
- How is confounding dealt with in this study?
- Are there any potential confounders that the authors have not taken into account? What might the likely impact be on the results?

A guide to reading scientific articles – Qualitative studies

What is the title of the study?

- Does the title clearly describe the study focus?
- Does it contain details about the population and the study design?

What is the research question?
Was a qualitative approach appropriate?

- Identify the study design and if it was appropriate for the research question.

How were the setting and the subjects selected?

- What sampling strategy was used?
- How were participants recruited?
- Where was the study conducted?

Was the sampling strategy appropriate for the approach?

- Consider the qualitative approach used and decide if the sampling strategy or technique is appropriate

What was the researcher's position, and has this been taken into account?

- Consider the researcher's background, gender, knowledge, personal experience and relationship with participants

What were the data collection methods?

- How was data collected? What technique was used?

How were data analysed, and how were these checked?

- How did the authors analyse the data? Was this stated?
- Did two or more researchers conduct the analysis independently, and were the outcomes compared (double coding)?
- Did the researchers come to a consensus, and how were disagreements handled?

Are the results credible?

- Does the result answer the research question?
- Are themes presented with quotes and do they relate to the research question or aim?

Are the conclusions justified by the results?

- Have the findings been discussed in relation to existing theory and previous research?
- How well does the interpretation of the findings fit well with what is already known?
  Are the findings transferable to other settings?
- Can the findings be applied to other settings? Consider the sample.

Now that you know how to critically appraise both quantitative and qualitative papers, it is also important to note that numerous critical appraisal tools exist. Some have different sub-tools for different study designs, while others are designed to be used for multiple study designs. These tools aid the critical appraisal process as they contain different questions to prompt the reader while assessing the study's quality.[9] Examples of tools commonly used in health professions are listed below in Table 7.2. Please note that this list is not exhaustive, as numerous appraisal tools exist. You can use any of these tools to appraise the quality of an article before choosing to use their findings to inform your own research or to change practice.

Table 7.2 Critical appraisal tools

Tool name	Type of Research	Website
Critical Appraisal Skills Programme (CAS) (UK)	Quantitative, Qualitative, Systematic Reviews, Economic evaluation	https://casp-uk.net/casp-tools-checklists/
CEBM (Oxford's Centre for Evidence Based Medicine	Systematic Reviews, Diagnostic Accuracy	https://www.cebm.ox.ac.uk/resources/ebm-tools/critical-appraisal-tools

	Studies, Prognosis Studies, Randomised Controlled Trials (RCT), Qualitative Studies, Individual Patient Data Reviews	
PEDro Scale (Physiotherapy evidence database)	Randomised Controlled trials only	https://pedro.org.au/english/resources/pedro-scale
Joanna Briggs Institute (JBI) Critical Appraisal Tools	Quantitative, qualitative, economic evaluation, systematic reviews	https://jbi.global/critical-appraisal-tools
CanChild/McMaster EBP Research Group-Evidence Review Forms	Quantitative and Qualitative	https://canchild.ca/en/resources/137-critical-review-forms-and-guidelines
Mixed Methods Appraisal Tool	Systematic mixed studies reviews	http://mixedmethodsappraisaltoolpublic.pbworks.com/w/page/24607821/FrontPage

	(reviews including original qualitative, quantitative and mixed methods studies)	
AMSTAR 2	Systematic reviews that include randomised or non-randomised studies of healthcare interventions	https://amstar.ca/Amstar-2.php
QUADAS-2	Diagnostic accuracy studies	https://www.acpjournals.org/doi/full/10.7326/0003-4819-155-8-201110180-00009?rfr_dat=cr_pub++0pubmed&url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org

4. CONCLUSION

This last chapter focuses on critical appraisal and quality assurance of research evidence, as highlighted in the opening scenario. The thalidomide tragedy highlights the crucial importance of critically appraising peer-reviewed literature to evaluate the quality of evidence in research. In this case, the drug was prescribed to pregnant women based on anecdotal evidence and positive testimonials, rather than rigorous scientific testing. If the manufacturer had conducted proper scientific studies and if doctors had critically appraised the available evidence, they would have discovered the drug's harmful effects and prevented the tragedy.

In research, it is crucial to collect and analyse enough high-quality data to draw valid and reliable conclusions. This means using appropriate methods to gather data, ensuring that the sample is representative, and minimizing bias in the data collection and analysis processes. Failing to gather sufficient evidence, or relying on inadequate or unreliable data, can result in flawed research that is not generalizable or replicable. Additionally, researchers must critically evaluate the evidence they have gathered and avoid jumping to conclusions or making premature claims. They should acknowledge the limitations of their findings and remain open to alternative explanations and interpretations of the data. They should also be transparent about their methods and share their data and findings with the scientific community to encourage scrutiny and replication.

Overall, it is essential to protect the well-being of individuals and society as a whole, and ensure that decisions are grounded in evidence-based research.

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VERSIONING HISTORY

This page provides a record of edits and changes made to this book since its initial publication in the JCU Open eBooks Collection. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.1. If the edits involve substantial updates, the version number increases to the next full number.

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Version	Date	Update	Location in eBook (eg. Chapter, section)
1.0	22 February, 2023	Date of publication	

GLOSSARY TERMS

Abstract

This is a brief summary of the paper which outlines the aim, methods used, results obtained, and conclusion.

Action Research

This type of research involves a cyclical process of planning, action, observation, and reflection to improve practice or address a problem.The goal of action research is to generate new knowledge and understanding about a specific issue while at the same time taking action to improve the situation.

Alternative hypothesis

This hypothesis states that there is a significant difference between variables.

Authority

This refers to a person or organisation having political or administrative power and control.

Axiology

This refers to the researcher's understanding of values and their role in research.

Beneficence

The ethical principle that requires actions that promote the well-being and interests of others.

Case-control study

This is a retrospective study in which the researcher compares a group of individuals with a specific outcome (cases) to a group of individuals without that outcome (controls) to identify factors associated with the outcome.

Cohort study

This is a longitudinal study in which the researcher follows a group of individuals who share a common characteristic (e.g., age, occupation) over time to monitor the occurrence of a particular health outcome.

Conclusion

This is the final section of the research paper, where the main findings are summarized, and the implications for future research are discussed.

Confirmability

This is the degree to which the findings are determined by respondents and conditions of the inquiry and not by the biases, motivations, interests or perspectives of the inquirer.

Confounding variable

This is a variable that mixes or muddles the effect or distorts the association between the dependent and independent variables, causing a spurious association.

Constructivism

This approach emphasizes the importance of understanding multiple perspectives and the subjective experiences of individuals

Content analysis

This is a method of unobtrusively investigating vast volumes of textual material to detect trends and patterns in words used, their frequency, their connections, and the structures and discourses of communication.

Convenience sampling

This is a technique used to recruit participants who are representative of the population from which they are selected but chosen because they are easily accessible and convenient to the researchers rather than being randomly selected

Convergent mixed methods design

This is a mixed methods design in which quantitative and qualitative data are collected simultaneously but analyzed separately, and the results are merged or integrated.

Credibility

This refers to the degree to which the findings of a study are believable, trustworthy, and accurate.

Critical appraisal

This refers to the process of carefully and methodically reviewing research to determine its credibility, usefulness, and applicability.

Cross-sectional study

This is an observational study in which the researcher collects data on a group of participants at a single point in time.

Data collection

This is the process of gathering information for research purposes.

Dependability

This refers to findings that are consistent and sustainable over time.

Descriptive qualitative study

This type of study design describes a situation, problem, phenomenon, service or programme. It focuses on discovering the who, what, and where of events or experiences and gaining insights from informants regarding a poorly understood phenomenon.

Discourse analysis

This type of analysis explores language in use instead of psychological factors such as attitudes, memories, or emotions.

Discussion section

A part of a paper that interprets the results, relate them to the background and objectives of the study and draws conclusions

Embedded design

This involves embedding one research design into another to generate new insights, and it is also known as nested design.

Epistemology

This describes how knowledge about reality is acquired, understood, and utilised.

Ethical principles

This refers to those general rules that operate as a foundational rationale for the numerous specific ethical guidelines and assessments of human behaviour.

Ethnography

This is the study of culture and entails the observation of details of everyday life as they naturally unfold in the real world. It is commonly used in anthropological research, which focuses on the community.

Explanatory sequential design

This is a mixed methods design characterised by the collection and analysis of quantitative data, followed by the collection and analysis of qualitative data.

Exploratory sequential design

This is a mixed methods design that involves the initial collection of qualitative data, and the findings are used to guide the design and development of the quantitative data collection tools.

Generalizability

The extent to which the results of a study can be applied to other settings or populations.

Grounded Theory

This is a qualitative research method that entails developing theories based on evidence that has been collected from the participants.

Hypothesis

This is a foundation and logical construct between a research problem and its solution, and it expresses a possible answer to a research question.

Inductive data analysis

This type of data analysis involves coding of data without trying to fit it into a pre-existing coding frame or the researcher's analytic preconceptions.

Inductive reasoning

This is commonly employed in qualitative research and focuses on specific observations, identifies patterns and regularities, formulates hypotheses that could be explored and develop conclusions.

Interpretivism

This is an epistemological stance that is based on the belief that knowledge is constructed through human interpretation and social interactions. It emphasizes the subjective and interpretive nature of human experience.

Introduction

This is the beginning that establishes the tone for the rest of the paper by providing pertinent background information and stating the issue that needs to be discussed in great detail.

Intuition

This is knowledge from the ability to understand or know something immediately based on feelings rather than facts. It is also described as instinctive knowing without the use of cognitive processes or emotionally charged judgments that result from quick, unconscious, and holistic associations.

Justice

The concept of fairness and the application of moral principles to ensure equitable treatment.

Literature Review

This is a critical evaluation and analysis of existing literature on a particular topic or research question.

Logic reasoning

This is a process of knowledge generation that requires the application of reasoning or logic. This is also known as rationalism.

Methodology

This is the strategy or action plan that informs the choice and use of particular methods within the context of a particular research paradigm.

Mixed methods research

This is a research design that combines both quantitative and qualitative research methods in a single study to gain a more comprehensive understanding of a phenomenon.

Multiphase design

In this approach, multiple projects with a common goal are conducted. This method requires multiple designs to be conducted over time with linkages in place to ensure that each phase builds on the previous one.

Narrative inquiry

This is a type of qualitative research method that seeks to understand how individuals make meaning of their lives and the world around them through studying their stories and experience.

Non-maleficence

This is the ethical principle that requires actions that avoid or minimize harm to others.

Null hypothesis

This hypothesis states that there is no statistical difference exists between two variables or in a set of given observations.

Observations

This method of data collection involves the researcher observing and recording the behaviour and interactions of individuals or groups in a natural setting.

Operational hypothesis

This is a more specific statement that provides a detailed description of how the variables in the study will be measured and predict how they will be related to one another.

Paradigm

This refers to a set of theories, assumptions, and ideas that contribute to one's worldview and approach to engaging with other people or things. It is the lens through which a researcher views the world and examines the methodological components of their research to make a decision on the methods to use for data collection and analysis.

Phenomenology

This is a research approach that seeks to understand the essence of a particular phenomenon through a detailed exploration of individual experiences. It is especially beneficial for exploring personal experiences such as emotions, perceptions, and awareness.

Positivism

This is an epistemological stance that is grounded in the idea that knowledge can be gained through objective observation and measurement.

Pragmatism

This is an epistemological stance that is focused on the practical application of knowledge. Researchers who adopt a pragmatic stance aim to create research that is both theoretically sound and applicable to real-world settings.

Primary research

This is original research published in peer-reviewed journals. It also includes reports, congress papers, dissertations and preprints.

Purposive sampling

This is a type of sampling technique that entails the deliberate, purposeful recruitment of individuals who can offer in-depth, precise details on the topic being studied. It is also known as purposeful or selective sampling.

Qualitative research

This is a research methodology that aims to uncover the meaning and understanding of phenomena that cannot be broken down into measurable elements.

Quantitative research

This is a type of research methodology that seeks to investigate and understand the relationship between different variables. It is concerned with employing numerical data to systematically examine the phenomenon under investigation.

Randomized controlled trial (RCT)

A type of experimental study in which participants are randomly assigned to the intervention or control arm of the study.

Reliability

This refers to the extent to which the research findings are consistent and replicable.

Research

This is defined as a thorough investigation of a topic or subject to learn new information or develop knowledge of it. It is a critical process that involves asking and attempting to answer questions about the world.

Rigour

This refers to the degree to which a study is conducted in a systematic, thorough, and accurate way.

Sampling technique

The process of selecting participants for a research study.

Scientific method

This is an empirical method for systematically gathering and analysing data to test hypotheses and answer questions.

Semi-structured interview

This is a data collection method that relies on asking questions within a predetermined framework. It utilises a general interview guide which consists of key questions that help define the area to be explored. This approach allows the interviewer and/or respondent to diverge and explore ideas or responses in more detail.

Snowball sampling technique

This is a sampling technique used when it is hard to reach potential participants such as members of minority groups. The researcher initially contacts a few potential participants and asks them to provide contact details of people or refer people they know who meet the selection criteria.

Thematic analysis

This is a technique for finding, examining, classifying, and reporting themes in data collection. It involves identifying codes or units of analysis that emerge from the data. Thematic analysis is the most common form of qualitative data analysis.

Theoretical sampling

This is a data collection process controlled by a theory generation process. It involves the simultaneous collection, coding and analysis of data to identify the next stage of data collection and where to find the participants to develop the emerging theory.

Transferability

This refers to the extent to which the findings of the study can be applied to other settings and contexts

Triangulation

This is also known as the integration of data. It refers to the process of linking multiple methods, data sources, or perspectives to gain a more comprehensive understanding of a research problem.

Trustworthiness

This is the degree to which the findings of a study can be trusted to be credible, authentic, and dependable.

Unstructured interview

This is also known as an informal conversational interview. It consists of questions that are spontaneously generated in the natural flow of conversation, reflect no preconceptions or ideas and have little or no organisation.

Validity

This refers to the accuracy of a measure. It is the extent to which a study or test accurately measures what it sets out to measure.